Abstracts of the

3rd INTERNATIONAL CONFERENCE

Micro&Nano 2007

on Micro-Nanoelectronics, Nanotechnology & MEMs

Athens, Greece
18 – 21 November 2007

CONFERENCE COMMITTEES

Conference chair

Dr Androula G. Nassiopoulou
e-mail: A.Nassiopoulou@imel.demokritos.gr
Tel.: (+30-21065) 33781 & 42783

Organizing Committee

Dr P. Argitis	IMEL/NCSR Demokritos, GREECE
Prof. A. Georgakilas	Department of Physics, Univ. of Crete, GREECE
Dr N. Glezos	IMEL/NCSR Demokritos, GREECE
Prof. S. Kennou	Depart. of Chem. Engineering, Univ. of Patras, GREECE
Dr E. Gogolides	IMEL/NCSR Demokritos, GREECE
Prof. G. Kiriakidis	Depart. of Physics, Univ. of Crete, GREECE
Prof. Ph. Komninou	Dep. of Physics, Aristotle Univ. of Thessaloniki, GREECE
Dr G. Konstantinidis	IESL/FORTH, Crete, GREECE
Dr A. G. Nassiopoulou	IMEL/NCSR Demokritos, GREECE
Dr N. Papanikolaou	IMEL/NCSR Demokritos, GREECE
Prof. N. Stefanou	Depart. of Physics, University of Athens, GREECE
Dr V. Tsakalos	IRC Help-Forward, GREECE
Dr A. Tserepi	IMEL/NCSR Demokritos, GREECE
Prof. D. Tsoukalas	School of Applied Mathematics and Physics, NTUA, GREECE
Dr X. Zianni	TEI of Chalkida, GREECE

Local Supporting Group

V. Giannetta	IMEL/NCSR Demokritos, GREECE
M. Huffman	IMEL/NCSR Demokritos, GREECE
M. Karmpadaki	IMEL/NCSR Demokritos, GREECE
Z. Makridi	IMEL/NCSR Demokritos, GREECE
F. Zacharatos	IMEL/NCSR Demokritos, GREECE

International Scientific Committee

Dr J. Ahopelto	VTT, FINLAND
Dr F. Balestra	IMEP/INPG/ENSERG, Grenoble, FRANCE
Dr M. Bersani	Fondazione Bruno Kessler - irst, Povo (Trento), Italy
Prof. V. E. Borisenko	Univ. of Information Science & Electronics, Minsk, BELARUS
Prof. L. Canham	pSiMedica Ltd. UK
Prof. C. Claeys	IMEC Strategic Relations, Professor KU, Leuven, BELGIUM
Prof. C. Fotakis	IESL/FORTH, Crete, GREECE
Prof. N. Grandjean	IPEQ-LASPE, SWITZERLAND
Prof. D. E. Ioannou	ECE Dept., George Mason University, USA
Dr E. I. Kamitsos	National Hellenic Research Foundation, Athens, GREECE
Prof. P. Kelires	Cyprus Univ. of Technology, CYPRUS
Dr I. Kleps	Laboratory of Nanotechnology, IMT-Bucharest, ROMANIA
Prof. E. Kohn	Depart. of Electron Devices&Circuits, Univ. of Ulm, GERMANY
Prof. C. Krontiras	Dept. of Physics, Univ. of Patras, GREECE
Prof. S. Logothetidis	Department of Physics, AUTH, GREECE
Dr J. Millan	CNM/IMB, SPAIN
Prof. T. D. Moustakas	Boston University, Boston, USA
Dr D. Niarchos	NCSR “Demokritos”, GREECE
Prof. S. Ossicini	INFM-S3, Univ. di Modena e Reggio Emilia, ITALY
Prof. A. Othonos	Physics Department, University of Cyprus, CYPRUS
Prof. R. Plana	CNRS-LAAS, Toulouse, FRANCE
Prof. A. Saar	Racah Instit. of Physics, Hebrew Univ. of Jerusalem, ISRAEL
Prof. C. M. Sotomayor Torres	Tyndall National Institute, University College Cork, IRELAND
Prof. C. Soukoulis	Iowa State University, Iowa, USA
Prof. M. C. Tringides	Department of Physics, Iowa State University, USA
Prof. L. Ventura	Univ. Of Tours, FRANCE

SUPPORTING ORGANIZATIONS

Demokritos National Centre for Scientific Research

imel NCSR Demokritos

Micro&Nano

FORTH

ΠΑΝΕΠΙΣΤΗΜΙΟ ΚΡΗΤΗΣ

UNIVERSITY OF PATRAS

ARISTOTLE UNIVERSITY OF THESSALONIKI

πράξη ΔΙΑΧΥΣΗ ΤΕΧΝΟΛΟΓΙΑΣ Innovation Relay Centre Help-Forward IRC network

NATIONAL & KAPODISTRIAN UNIVERSITY OF ATHENS ΕΘΝΙΚΟΝ & ΚΑΠΟΔΙΣΤΡΙΑΚΟΝ ΠΑΝΕΠΙΣΤΗΜΙΟΝ ΑΘΗΝΩΝ

National Technical University of Athens N.T.U.A.

EXHIBITORS - SPONSORS

- Innovation Relay Centre, Help-Forward πράξη ΔΙΑΧΥΣΗ ΤΕΧΝΟΛΟΓΙΑΣ Innovation Relay Centre Help-Forward
- S. Argyropoulos, International Technology Corporation ITC
- N. Asteriadis S. A., www.asteriadis.gr N. ΑΣΤΕΡΙΑΔΗΣ Α.Ε.
- Innovative Solutions for Nanofabrication and Semiconductor Navigation Raith INNOVATIVE SOLUTIONS FOR NANOFABRICATION AND SEMICONDUCTOR NAVIGATION

PREFACE

This book contains the abstracts of the 3rd International Conference on Micro-Nanoelectronics, Nanotechnology and MEMs.

Micro&Nano2007 is the third of a series of Conferences held at NCSR “Demokritos” in Athens-Greece.

The Conference aims at gathering together in an interactive forum all scientists and engineers working in the challenging field of Micro- Nanoelectronics, Nanotechnology and MEMs and to stimulate discussions in last achievements and new developments in this rapidly evolving field.

The Conference combines an extensive scientific programme, including oral and poster sessions, exhibition and social events.

The first and second Conferences were held in the years 2000 and 2004 and gathered together ~150 scientists from all over the world that discussed last achievements in the rapidly evolving field of Micro-Nanoelectronics, Nanotechnology and MEMs. This year, more than 200 abstracts were submitted from 23 different countries.

On behalf of all the members of the Organizing Committee, I look forward to welcome all Micro&Nano 2007 participants to Athens and wish them a fruitful and enjoyable Conference.

Dr. A. G. Nassiopoulou

Chairperson of the Conference

ORAL PROGRAMME

SUNDAY, NOVEMBER 18, 2007

18^{00} – 21^{00}	**Reception – Social programme**
	Registration
	Award ceremony
	Award plaque to Prof. G. Kamarinos, Director of Research CNRS, France, Director of LPCS/CNRS 1978-'93, in recognition of his contribution to the early stages of Microelectronics Research in Greece
	Light dinner

MONDAY, NOVEMBER 19, 2007

Session 1: Devices

09^{00} – 09^{30}	**Welcome**
09^{30} – 10^{00}	Si Nanoelectronic Devices – **I1** **Wei-Xin Ni (Invited speaker)**
10^{00} – 10^{30}	Micro and Nano on Insulator– **I2** **S. Cristoloveanu (Invited speaker)**
10^{30} – 10^{45}	Electrical characterization of InAs-nanocrystal-based nonvolatile memories - MN178 **M. Hocevar, P. Regreny, M. Gendry, A. Souifi**
10^{45} – 11^{00}	Semi-analytical modelling of short channel effects in sub-50 nm Si symmetrical gate-all-around MOSFETs – MN27 **A. Tsormpatzoglou[1], C. A. Dimitriadis[1], R. Clerc[2], Q. Rafhay[2], G. Pananakakis[2], G. Ghibaudo[2]**
11^{00} – 11^{30}	***Coffee Break***

Session 2: Light emitting materials and devices

11^{30} – 12^{00}	Growth of III-Nitride quantum dots and their applications to blue-green LEDs– **I3** **T. D. Moustakas (Invited speaker)**
12^{00} – 12^{15}	GaN epitaxy on γ-LiAlO2(100) substrates – MN149 **A. Mogilatenko[1], W. Neumann[1], E. Richter[2], M. Weyers[2], B. Velickov[3], R. Uecker[3]**
12^{15} – 12^{30}	Single dot spectroscopy on InAs/GaAs piezoelectric quantum dots – MN129 **G. E. Dialynas[1], C. Xenogianni[1,2], S. Tsintzos[1,2], P. G. Savvidis[1,2], G. Constantinidis[1], Z. Hatzopoulos[1,3], N. T. Pelekanos[1,2,*]**
12^{30} – 12^{45}	Nanoscale Structure of GaN Nanowires Grown on Various Substrates – MN63 **Th. Kehagias[1,*], Ph. Komninou[1], G.P. Dimitrakopulos[1], C. Chèze[2], L. Geelhaar[2], H. Riechert[2], H. Kirmse[3], W. Neumann[3], and Th. Karakostas[1]**
12^{45} – 14^{30}	***Lunch Break***

Session 3: Micro and Nano fabrication I

14^{30} – 15^{00}	Nanoimprint lithography and self-assembly as prospective technologies for heterogeneous integration– **I4** **Clivia M. Sotomayor Torres (Invited speaker)**
15^{00} – 15^{15}	Nanopatterning the Si Surface Through Porous Anodic Alumina Masking Layers - MN172 **F. Zacharatos, V. Gianneta and A. G. Nassiopoulou**

15^{15} – 15^{30}	Three-dimensional quasi-regular Ni nanostructure-array in a porous silicon membrane correlated with magnetic characteristics – MN92 **P. Granitzer[1], K. Rumpf[1], P. Pölt[2], S. Šimić[2], H. Krenn[1]**
15^{30} – 15^{45}	Selective Photochemical Etching of GaN Films Following Laser Lift-off – MN174 **Trichas E.[1.2], Xenogianni C.[1.2], Kayambaki M.[2], Iliopoulos E.[2], Savvidis P.[1,2], Pelekanos N.[1,2]**
15^{45} – 16^{00}	Growth and characterization of InxAl1-xN/GaN heterostructures, throughout the whole composition range, by plasma-assisted MBE – MN82 **A. Adikimenakis*, E. Iliopoulos, G. Tsiakatouras, K. Tsagaraki, A. Georgakilas**
16^{00} – 16^{30}	***Coffee Break***

Session 4: Sensors and MEMs

16^{30} – 17^{00}	RF MEMS: Status and perspectives– **I5** **R. Plana (Invited speaker)**
17^{00} – 17^{15}	A Chemocapacitive sensor array system for detection of complex odors – MN140 **S.Dimopoulos, M. Kitsara, D. Goustouridis, I. Raptis, S. Chatzandroulis**
17^{15} – 17^{30}	MEMS Composite Porous Silicon/Polysilicon Cantilevers for Biosensing Applications– MN119 **S. Stolyarova[1], R.E. Fernandez[2], A. Chadha[3], E. Bhattacharya[2], Y. Nemirovsky**
17^{30} – 17^{45}	Fuel cell electrodes on the basis of porous silicon – MN152 **V. V. Starkov**
17^{45} – 18^{00}	System integration via development of chip embedding technologies in rigid and flex printed circuit boards – MN95 **D. Manessis[1], A. Ostmann[1], T. Loeher[2], and H. Reichl[1]**
18^{00} – 18^{15}	A wireless sensor network for building structural health monitoring and seismic detection – MN116 **P. Katsikogiannis[1], E. Zervas[1], G. Kaltsas[1]**

18^{15} – 21^{00} POSTER SESSION 1

Materials fabrication and characterization

TUESDAY, NOVEMBER 20, 2007

Session 5: Micro and Nano fabrication II

09^{00} – 09^{30}	High-resolution 3D nanomanufacturing with ultrashort laser pulses– **I6** **Boris N. Chichkov (Invited speaker)**
09^{30} – 10^{00}	More than Moore by VLSI N(M)EMS on CMOS– **I7** **P. Vettiger (Invited speaker)**
10^{00} – 10^{15}	Three-dimensional photonic crystals containing a nonlinear optical chromophore – MN91 **M. Farsari[1*], A. Ovsianikov[2], M. Vamvakaki[1], B.N. Chichkov[1,2], C. Fotakis[1]**
10^{15} – 10^{30}	Novel Photonic Media Based on Nanostructured Semiconductors and Dielectrics – MN127 **Pavel K. Kashkarov, Leonid A Golovan', Stanislav V. Zabotnov, Dmitri A. Mamichev, Victor Yu. Timoshenko**
10^{30} – 10^{45}	Random Laser Action in ZnO Nanohybrids – MN113 **A. Stassinopoulos[1,2], E. D. Tsagarakis[3], Rabindra N. Das[3], S. H. Anastasiadis[1,4], E. P. Giannelis[3], Dimitris G. Papazoglou[5], D. Anglos[1]**
10^{45} – 11^{00}	Fabrication of micron-scale GaN-based devices via AlInN selective oxidation and etching – MN78 **A. Castiglia, D. Simeonov, H. J. Buehlmann, J. Dorsaz, A. Altoukhov, J.-F. Carlin, E. Feltin, R. Butté, and N. Grandjean**
11^{00} – 11^{30}	***Coffee Break***

Session 6: Nanostructures and Applications

11^{30} – 12^{00}	The Electrical Transport Mechanisms in Ensembles of Silicon Quantum Dots **I. Balberg (Invited speaker)** – I8
12^{00} – 12^{15}	Micro and nano – scale silicon : potential applications in toothpaste – MN24 **L. Canham**
12^{15} – 12^{30}	Silicon nanocrystals as efficient photosensitizers of erbium ions for optoelectronic applications – MN132 **V. Yu. Timoshenko[1], O.A. Shalygina[1], D.M. Zhigunov[1], S.A. Dyakov[1], N.I. Komarevsky[1], P. K. Kashkarov[1], M. Zacharias[2], M. Fujii[3], and Sh. Hayashi[3]**
12^{30} – 12^{45}	Determination of critical points of nanocrystalline silicon films: the role of grain boundaries in the optical properties – MN48 **E. Lioudakis[1,*], Andreas Othonos[1] and A. G. Nassiopoulou[2]**
12^{45} – 13^{00}	New effects in finite-length silicon nanowires – MN161 **A. D. Zdetsis, E. N. Koukaras , C. S. Garoufalis**
13^{00} – 14^{30}	***Lunch Break***

Session 7: Devices

14^{30} – 14^{45}	Influence of current injection on the electroluminescence properties of GaN-based LEDs – MN59 **C. Salcianu[1, 2], T. Thrush[1], C. McAleese[1], C. Humphreys[1]**
14^{45} – 15^{00}	Metallic Contacts Effect Estimation on (SI) GaAs Soft X-Ray Radiation Detectors Performance – MN98 **V. G. Theonas[1*], G. Konstantinidis[2], G. J. Papaioannou[1]**
15^{00} – 15^{15}	Photochemical study of red fluorescent emitters for application in Organic Light Emitting Diodes (OLEDs) – MN171 ***D. Georgiadou[1,3], M. Vasilopoulou[1], G. Pistolis[2],D. Dimotikalli[3],P. Argitis[1*]***
15^{15} – 15^{30}	Deposition and electrical characterization of hafnium oxide films on silicon – MN64 **E. Verrelli[1], D. Tsoukalas[2], D. Kouvatsos[3]**
15^{30} – 15^{45}	Physics Based Capacitance Modeling of Short-Channel Double Gate MOSFETs – MN13 **Håkon Børli, Kristian Vinkenes and Tor A. Fjeldly**
15^{45} – 16^{00}	Numerical simulation of quantum transport in DGMOS using Coupled Poisson-deterministic Wigner-Schrödinger equations – MN187 **J. Kefi-Ferhane & A. Poncet**
16^{00} – 16^{30}	***Coffee Break***

Session 8: Fabrication and characterization of nanostructures (parallel session)

16^{30} – 16^{45}	Strain relaxation in AlN/GaN heterostructures grown by molecular beam epitaxy – MN66 **G.P. Dimitrakopoulos[1,*], Ph. Komninou[1], Th. Kehagias[1], S.-L. Sahonta[1], J. Kioseoglou[1], I. Hausler[2], W. Neumann[2], E. Iliopoulos[3], A. Georgakilas[3], and Th. Karakostas[1]**
16^{45} – 17^{00}	TEM investigations of (In,Ga)N QWs by TEM – MN50 **P. Manolaki[1], I. Häusler[1], H. Kirmse[1], W. Neumann[1], J. Smałc[2,3], & J. Kozubowski [3]**
17^{00} – 17^{15}	TEM characterization of VLS-grown ZnTe nanowires – MN148 **H. Kirmse, W. Neumann, S. Kret, P. Dłużewski, E. Janik, G. Karczewski, T. Wojtowicz**
17^{15} – 17^{30}	On advantages and limitations of Raman spectrometry for control of nanotube inclusions in polymer composites – MN123 **Eleni Spanou, George Vessiaris, Dr Andreas Kuprianou, Prof. Doumanidis Charalampos, Vladislav Ryzhkov**
17^{30} – 17^{45}	Nonlinear optical properties of Au nanoclusters encapsulated into hybrid block copolymer micelles – MN99 **Kostas Iliopoulos[1,2], Dimitris Athanasiou[1], Stelios Couris[1,2], Anastasia Meristoudi[3,4], Nikos Vainos[3,4], Stergios Pispas[3]**
17^{45} – 18^{00}	The properties of the nanometer thick Si/Ge films-on-insulator produced by Ge+ ion implantation and subsequent hydrogen transfer – MN157 **I. E. Tyschenko[1], M. Voelskow[2], A.r G. Cherkov[1], V. P. Popov[1]**

Session 9: Materials, devices and applications (parallel session)

16^{30} – 16^{45} Molecular Nanodevices based on Functionalized Cyclodextrins – MN136
Dimitrios Velessiotis[1], Davide Maffeo[2], Eleni Makarona[1], Viswanathan Chinnuswamy[1], Constantinos Milios[3], Konstantina Yannakopoulou[2], Irene Mavridis[2], Zoe Pikramenou[3] & Nikos Glezos[1]

16^{45} – 17^{00} Electronic structure investigation of Nickel Phthalocyanine thin film interfaces with inorganic and organic substrates – MN62
Foteini Petraki & Stella Kennou

17^{00} – 17^{15} Covalent Grafting of Glycine onto the Porous Silicon Surface – MN2
S. Sam[1, 3], A. C. Gouget-Laemmel[2], J-N. Chazalviel[2], F. Ozanam[2], N. Gabouze[1], S. Djebbar[3]

17^{15} – 17^{30} Applied nanoionics of advanced superionic conductors – MN154
A.L.Despotuli, A.V.Andreeva

17^{30} – 17^{45} Energetic calculations of the AlN/GaN interface – MN67
E. Kalessaki, J. Kioseoglou, G. P. Dimitrakopulos, Ph. Komninou*, and Th. Karakostas

17^{45} – 18^{00} Enhanced efficiency of narrow InGaN/GaN quantum wells – MN58
S.-L. Sahonta, Ph. Komninou[1], G.P. Dimitrakopulos, Th. Karakostas, C. Salcianu[2] and E.J. Thrush[2]

18^{00} – 21^{00} **POSTER SESSION 2**

Devices, Sensors and Microfluidics

Micro&Nano fabrication

Design, Integration, Systems, Photonics

21^{00} **CONFERENCE DINNER**

WEDNESDAY, NOVEMBER 21, 2007

Session 10: Semiconductors Devices and Applications in Life-Sciences

9^{00} – 9^{30} Electrical Transport Through Self-Assembled Hydrophobin Protein Membrane– **I9**
J. Ahopelto (Invited speaker)

9^{30} – 10^{00} Nanotechnology Advances in Controlled Drug Delivery Systems– **I10**
C. Kiparissides (Invited speaker)

10^{00} – 10^{15} Micro- and Nano-particle manipulation by joint Dielectrophoresis and AC Electroosmosis: Devices for particle trapping utilizing both phenomena - MN189
N. G. Loucaides[1], A. Ramos[2] and G. E. Georghiou[1]

10^{15} – 10^{30} Control of nano-topography and wetting properties of polymers: application in PMMA and PDMS – MN139
N. Vourdas, M.-E. Vlachopoulou, A. Tserepi, E. Gogolides

10^{30} – 11^{00} ***Coffee Break***

Session 11: Monolithic integration on semiconductor substrates

11^{00} – 11^{15} Broadband Electrical characterization of Porous Silicon at Microwave Frequencies – MN60
H. Contopanagos, D. Pagonis, A. G. Nassiopoulou

11^{15} – 11^{30} Low energy loss rf circuits on nanostructured porous silicon layers – MN77
A. Porcher*, B. Remaki, C. Malhaire, D. Barbier

11^{30} – 11^{45} High-frequency scalable compact modelling of Si RF-CMOS technology – MN151
A. Bazigos[1], M. Bucher[2], P. Sakalas[3], M. Schroter[3]

11^{45} – 12^{00} Semiconductor neuronal nanofibers for parallel computation – MN110
A. Samardak[1], S. Taylor[1], A. Nogaret[1], G. Hollier[2], J. Austin[2], D. Ritchie[3]

12^{00} – 12^{15} Monolithic integrated microring resonators: The fundamental building block towards "Dense" photonic integration – MN196
S. Mikroulis, D. Syvridis

Session 12: Polymeric materials and devices

12^{15} – 12^{45}	Molecular nanotechnologies for plastic organic/biologic devices– **I11** **R. Cingolani (Invited speaker)**
12^{45} – 13^{00}	Photoresponsive Polymer Surfaces – MN44 **S. H. Anastasiadis,[1,2] M. I. Lygeraki,[1] K. Lakiotaki,[1] M. Varda,[1] E. Tsiranidou,[1] A. Athanassiou,[1,3] M. Farsari,[1] D. Pisignano,[3] and R. Cingolani[3]**
13^{00} – 13^{15}	Photoinduced reversible diffraction efficiency of lithographic gratings on nanocomposite films containing photochromic molecules – MN141 **D. Fragouli, D. Pisignano, G. Paladini, G. Caputo, D. Cozzoli, R. Cingolani, A. Athanassiou**
13^{15} – 14^{30}	***Lunch Break***

Session 13: Nanostructures and characterization techniques

14^{30} – 14^{45}	Optical properties of silicon based nanostructures – MN33 **A. Sa'ar, I. Balberg**
14^{45} – 15^{00}	Nanocrystalization of SM-FE-TA-N composites inside magnetic nanodroplets from fast cooling on tantalum surface – MN88 **E. Sarantoupolou[1], J. Kovač[2], M. Janeva[3], Z. Kollia,[1] S. Kobe[4], G. Dražić[4], A. C. Cefalas[1]**
15^{00} – 15^{15}	ANNA - Analytical Network for Nanotechnology – MN177 **M. Bersani[1], G. Pepponi[1], D. Giubertoni[1] and J. van den Berg[2]**
15^{15} – 15^{30}	Luminescence of lanthanides from xerogels embedded in mesoporous matrices – MN21 **N. V. Gaponenko[1], G. K. Malyarevich[1], D. A. Tsyrkunou[1], E. A. Stepanova[1], A. V. Mudryi[1], V. E. Borisenko[1], I. S. Molchan[2], P. Skeldon[2], G. E. Thompson[2]**
15^{30} – 15^{45}	Mechanochemistry in preparation of nanocrystalline semiconductors – MN4 **P. Baláž [1], E. Dutková [1], E. Gock [2]**
15^{45} – 16^{15}	***Coffee Break***

Session 14: Nanostructures: Materials and Devices

16^{15} – 16^{30}	Bias Dependence of Spin-Transfer Torque in Magnetic Tunnel Junctions – MN42 **I. Theodonis[1], N. Kioussis[2], A. Kalitsov[3], M. Chshiev[4], W.H. Butler[4]**
16^{30} – 16^{45}	Study of the r-plane sapphire nitridation for epitaxial growth of a-plane GaN by molecular beam epitaxy – MN135 **G. Tsiakatouras[1], J. Smalc[2], K. Tsagaraki[1], M. Androulidaki[1], Ph. Komninou[2] and A. Georgakilas[1]**
16^{45} – 17^{00}	SOI-nanowires as sensors of charge – MN8 **O.V. Naumova, D.A. Nasimov., B.I.Fomin, N.V.Dudchenko, T.A.Gavrilova, E.V. Spesivtsev, V.P.Popov**
17^{00} – 17^{15}	Calculated transport coefficients in a SET – MN100 **X. Zianni**
17^{15} – 17^{30}	Controlled Population Dynamics in Semiconductor Quantum Well and Quantum Dot Structures – MN101 **E. Paspalakis[1], C. Simserides[1], A. Fountoulakis[2] & A. F. Terzis[2]**

17^{30} – 19^{00} **CLOSING OF THE CONFERENCE**

POSTER PROGRAMME

Poster Session I - Monday 18^{15} - 21^{00}

Materials fabrication and characterization

P I.1 "Study of polystyrene film coating on the surface of porous silicon", **F-Z. Tighilt, S. Sam, N.Belhaneche and N. Gabouze**

P I.2 "Degradation of NO_2-nitrided oxides under electrical field stress and irradiation", **O.V.Naumova, B.I.Fomin, N.V.Sakharova, V.P.Popov**

P I.3 "Covalent and Non-Covalent Functionalization of Carbon Nanotubes and Carbon Nanohorns with Polymers", **G. Mountrichas, S. Pispas & N. Tagmatarchis,**

P I.4 "Liquid and gaseous stain etching of micro-machined silicon structures", **Vasily Melnikov, V. Yu. Timoshenko, E. Astrova, T. Perova, V. Srigengan, H. Gamble**

P I.5 "Nutritional applications of nanostructured silicon : an edible semiconductor", **L. Canham**

P I.6 "FeNi alloys electroplated into porous (n-type) silicon", **S.Ouir, S.Sam,G.Fortas, N.Gabouze, A. Manseri, K. Beldjilali**

P I.7 "Correlation between Transport, Dielectric & Optical Properties of Porous Silicon", **A. Sa'ar**

P I.8 "The role of H_2O molecules in the process of ammonia adsorption on the silicon nanostructures surface", **A. V. Pavlikov, Ivan B. Leukhin, A. A. Silaev, A. S. Vorontsov and V. Yu.Timoshenko**

P I.9 "Durability and photophysical properties of surfactant-covered porous silicon particles in aqueous suspensions", **María Balaguer, Ester Pastor, Leszek Bychto, Pedro Atienzar, Miguel A. Miranda,Vladimir Chirvony, Eugenia Matveeva**

P I.10 "Monitor the properties of silicon nanocrystals embedded in SiO2 matrix using ultrashort laser pulses", **E. Lioudakis, A. Othonos, A. Emporas' A. G. Nassiopoulou**

P I.11 "On the limits of a classical theory of crystalline defects: An application to type III-N nitrides", **A. Belkadi, T. D. Young, P. Dluzewski, . Chen, P. Lei Huaping & G. Nouet**

P I.12 "Analysis of TEM diffraction contrast of (In,Ga)N/GaN nanostructures", **P. Manolaki, I. Häusler, A. Mogilatenko, H. Kirmse, W. Neumann**

P I.13 "Influence of ultra-violet radiation on properties of nanostructured silicon", **S.P. Kulyk, M.M. Melnichenko & K.V. Svezhentsova**

P I.14 "Stabilized in Organic Media Hybrid Materials Based on Complexes of Well-Defined Functional Block Copolymers with Palladium(II) acetate", **M. Demetriou, T. Krasia-Christoforou**

P I.15 "Magnesium incorporation at InN (0001) and (000-1) surfaces: A first-principles study", **A. Belabbes, J. Kioseoglou, G. P. Dimitrakopulos, Ph. Komninou*, and Th. Karakostas**

P I.16 "Pulse electrochemical method for porosification of silicon and preparation of porSi dust with narrow particles size distribution", **Leszek Bychto, Yuri Makushok,Vladimir Chirvony, Eugenia Matveeva**

P I.17 "Analysis and defect characterization of III-nitride nanowires grown by Ni promoted MBE", **L. Lari , R. T. Murray , M. Gass , T. J. Bullough , P. R. Chalker , J. Kioseoglou, G. P. Dimitrakopulos, Th. Kehagias, Ph. Komninou, Th. Karakostas, C Chèze, L Geelhaar, H Riechert**

P I.18 "Hot-wire CVD of Copper films on Self-Assembled-Monolayers of MPTMS", **G. Papadimitropoulos and D. Davazoglou**

P I.19 "Molecular beam epitaxy of InN directly on Si(111) substrates", ***A. O. Ajagunna, A. Vajreyi, E. Iliopoulos, K. Tsagaraki, M Androulidaki, and A. Georgakilas**,

P I.20 "Influence of the different initiation procedures and substrate's miscut angle on the properties of epitaxial GaN-on-Si (111)", **A. Adikimenakis*, J. Domagala, K. Tsagaraki, Ph. Komninou, G.P. Dimitrakopulos and A. Georgakilas**

P I.21 "Structural and electrical characterization of phosphorus implanted germanium", **P. Tsouroutas, D. Tsoukalas , A. Florakis, I. Zergioti, N.Cherkashin, A. Claverie**

P I.22 "Surface functionalization of 3D structures using biomolecules", **A. Mourka[1,2] , V. Dinca [1,3], E. Kasotakis, J. Catherine, A. Mitraki, M. Farsari*, C. Fotakis**

P I.23 "Comparison of the magnetic behavior between Co- and Ni-nanostructures in silicon", **K. Rumpf, P. Granitzer, P. Pölt, S. Šimić, H. Krenn**

P I.24 "Comparative study of Zn1-xAlxO thin films and nanostructures deposited by different chemical routes", **G. Kenanakis, Z. Giannakoudakis, D. Vernardou, E. Koudoumas, N. Katsarakis**

P I.25 "Quantum effects in thin silicon rich oxide films", **A. Morales*, J. Barreto, C. Domínguez, M. Aceves**

P I.26 "Effects of Initial Conditions in Intersubband Population Dynamics of a Semiconductor Quantum Well", **E. Voutsinas, J. Boviatsis, E. Paspalakis & A. F. Terzis**

P I.27 "Propagation Effects and Switching Properties of Electromagnetically Induced Transparency in a Quantum Dot Structure", **A. Fountoulakis, E. Paspalakis & A. F. Terzis**

P I.28 "Structure and optical properties of natural biopolymers Chitin and Chitosan", **G. Luna-Bárcenas, J. Louvier-Hernández, Y. Vorobiev, J. González-Hernández**

P I.29 "Theoretical description of energy spectra of nanostructures assuming specular reflection of electron from the structure boundary", **Y. Vorobiev, P. Horley, P. Gorley, V. Vieira**

P I.30 "Photoluminescence of self-assembled single quantum dots in the linear regime", **A. Zora, C. Simserides, G. P. Triberis**

P I.31 "Study of the influence of α-particles irradiation in AlGaAs/GaAs heterojunction structures", **P. Georgakakos*, G. Papaioannou, G. Konstantinides and Z. Hatzopoulos**

P I.32 "Structure and photocatalytic performance of magnetic TiO2-Fe3O4 composites for the degradation of propachlor", **Vassiliki Belessi, Dimitra Lambropoulou, Radek Zboril, Vassilis Tzitzios, T. Albanis, D. Petridis**

P I.33 "Study of the early stages of Cr/4H-SiC(11-20) interface formation and its behavior at high temperatures", **I. Dontas*, S. Karakalos, S. Ladas and S. Kennou**

P I.34 "Effect of In composition in the bonding environment of In in InAlN and InGaN epilayers", **M. Katsikini, F. Pinakidou, E. C. Paloura, Ph. Komninou, E. Iliopoulos, A. Adikimanakis, A. Georgakilas, E. Welter**

P I.35 "Electron microscopy investigation of extended defects in non-polar gallium nitride layers deposited on r-plane sapphire", **J. Smalc*, Ph. Komninou, J. Kioseoglou, S.-L. Sahonta, G. Tsiakatouras, A. Georgakilas**

P I.36 "Micropores modification in InP", **D. Nohavica, P. Gladkov, Z. Jarchovsky, J. Zelinka and Ph. Komninou*, A. Delimitis, Th. Kehagias, Th. Karakostas**

P I.37 "Growth of ternary NiAlxSi2-x and NiGaxSi2-x layers on Si(001)", **A. Mogilatenko, F. Allenstein, A. Schubert, G. Beddies , H.-J. Hinneberg, W. Neumann**

P I.38 "Interface crystallography & capacitor properties of heterostructures based on advanced superionic conductors", **A.V. Andreeva and A.L. Despotuli**

P I.39 "Endotaxial growth of InSb nanocrystals on the bonding interface of silicon-on-insulator structure", **I. E. Tyschenko, M. Voelskow, A. G. Cherkov & V. P. Popov**

P I.40 "Influence of Ammonia and Parabenzoquinone Molecules Adsorption on Photoluminescence Properties of Silicon Nanocrystals Ensembles", **Y. V. Ryabchikov, A. S. Vorontsov, L. A. Osminkina, V. Yu. Timoshenko, P. K. Kahkarov**

P I.41 "Efficient IR Emission from Patterned Thin Metal Films on a Si Photonic Crystal", **P. Theodoni, P. Bayiati, M. Chatzichristidi, T. Speliotis, V. Vamvakas, I. Raptis, N. Papanikolaou**

P I.42 "Anodic Porous Alumina Thin Films on Si: Interface Characterization", **V. Gianneta, S. N. Georga, C. A. Krontiras, A. G Nassiopoulou**

P I.43 "Composition Analysis of Ternary Semiconductors by Combined Application of Conventional TEM and HRTEM", **I. Häusler, H. Kirmse, W. Neumann**

P I.44 "Polyoxometalate-Based Multilayers: Fabrication and Electrical Characterization", **Antonios**

M. Douvas*, Eleni Makarona, Dimitrios Velessiotis, Jerzy A. Mielczarski, Ela Mielczarski, Nikos Glezos, Panagiotis Argitis

P I.45 "Recharging of silicon nanocrystals embedded into oxide matrix: Q-DLTS study", **I.V. Antonova, E.P.Neustroev, S.A.Smagulova, Z.S. Yanovitskaya, J. Jedrzejewski, I. Balberg**

P I.46 "Carrier gas composition and growth temperature dependence of ELO GaN grown by HVPE", **O. GOURMALA, J. TOURRET, A. TRASSOUDAINE, Y. ANDRE, R. CADORET, D. CASTELLUCI, E. GIL**,

P I.47 "New technique for the production of stretch-aligned highly conducting and semi-crystalline polyaniline", **E. K. Chatzidaki, N. K. Kanellopoulos and N. Theophilou**

P I.48 "ZnO nanowire growth based on a low-temperature, silicon-compatible combinatorial method", **E. Makarona*, T. Speliotis, G. Niarchos, D. Niarchos and C. Tsamis**

P I.49 *"Effect of deposition pressure and post deposition annealing on SmCo thin film properties",* **T. Speliotis, E. Makarona, F. Chouliaras, C. Charitidis, C. Tsamis, Dimitris Niarchos**

P I.50 "Influence of different substrates on the ionic conduction in LiCoO2/LiNbO3 thin-film bi-layers", **E.E. Horopanitis, G. Perentzis and L. Papadimitriou**

P I.51 "Nanodiamond formation in hydrogenated amorphous carbon thin films", **S. Kassavetis, S. Lousinian, S. Logothetidis, I.Tsiaoussis, N. Frangis**

P I.52 "Optical properties of two dimensional arrays of metallodielectric Nanosandwiches", **N. Papanikolaou, G. Gantzounis, N. Stefanou**

P I.53 *"*Depletion of parallel conducting layers in high mobility In0.53Ga0.47As/ In0.52Al0.48As modulation doped field effect transistors*",* **E. Skuras, A. Gavalas, D. Spathara, D. Anagnostopoulos, C.R. Stanley**

P I.54 "Poisson ratio under compressive strain; effect on the mechanical response of the Cu46Zr54 metallic glass", **L. Tayebi, Ch.E. Lekka, G.A. Evangelakis**

Characterization

P I.55 "Auger Recombination in Silicon Nanocrystals", **M. Mahdouani, R. Bourguiga, S. Jaziri, S. Gardelis and A.G. Nassiopoulou**

P I.56 "Characterization of Electroless Copper Deposition into Porous Silicon", **S. Sam, N. Gabouze, S. Djebbar**

P I.57 *"Electrical investigations of the InAs quantum dots in the AlO matrix",* ***O.R. Bajutova, A.G. Milekhin,O.V. Naumova, A.I. Toropov, A. Gutakovsky***

P I.58 "Optical properties of InAlN(0001) alloys in the whole composition range", **E. Iliopoulos[1], A. Adikimenakis, M. Androulidaki, G. Tsiakatouras and A. Georgakilas**

P I.59 "Optical Spectroscopy of Silicon Nanocrystals for Biomedical Applications", **Yury V. Ryabchikov, Alexander S. Vorontsov, Victor Yu. Timoshenko, Pavel K. Kahkarov**

P I.60 "Cr/4H-SiC Schottky contacts investigated by electrical and photoelectron spectroscopy techniques", **Koliakoudakis H., Dontas J., Kayambaki M. , Ladas S., Konstantinidis G., Zekentes K., Kennou S.**

P I.61 "Fano effect in quasi-one-dimensional wires with short- and finite-range impurities", **Vassilios Vargiamidis, Philomela Komninou, and Hariton M. Polatoglou**

P I.62 "Comparison between SIMS and NRA for obsidian hydration dating purposes", **D. Grambole, W. Pilz, Th. Ganetsos, I. Liritzis and N. Laskaris**

P I.63 "Nano- and micro- scale resolution in ancient Obsidian artefact surfaces: The impact of AFM on the obsidian hydration dating by SIMS-SS", **I. Liritzis, N.Laskaris and M. Bonini**

P I.64 "In-situ ellipsometric study of Ge+ ion implanted SiO2 layers under conditions of rapid thermal annealing", **V.A. Shvets, I.E. Tyschenko, S.I. Chikichev, & V.Yu. Prokopiev**

P I.65 "Assembly and electrical investigation of tiopronin- and citrate-stabilized Au nanoparticle chains between electrodes on patterned oxidized Si substrates under the influence of an electric field", **A Zoy and A G Nassiopoulou**

P I.66 "TEM characterization of ultra-thin nanocrystalline Si films grown on quartz and presenting quantum properties", **Ch.B. Lioutas, N. Vouroutzis, I. Tsiaoussis, N. Frangis, A.G. Nassiopoulou**

P I.67 "Evolution of photoluminescence and chemical composition of the nanostructured silicon in

water solutions", **V. Shevchenko, V. Makara, T. Veblaya & V. Kravchenko**

P I.68 "A comparative study on the properties and structure of thermal annealed silicon-rich-oxide using different analysis techniques available within the European project ANNA (No.026134)", **M. Barozzi, P. Bellutti, M. Bersani, A. Picciotto, G. Pucker, L. Vanzetti**

P I.69 **"**Advanced analytics of nanolayers and nanostructures using X-ray fluorescence methods**", M. Kolbe, B. Beckhoff*, P. Hönicke, M. Müller, B. Pollakowski, and G. Ulm**

P I.70 "Temperature dependent EXAFS of InN", **M. Katsikini, F. Pinakidou, E. C. Paloura, Ph. Komninou, A. Georgakilas, E. Welter**

P I.71 "Photomodulated Thermoreflectance Microscopy on Ion Implanted Semiconducting Materials", **Christiana Sherifi , Maria D. Papademetriou, and Constantinos Christofides**

P I.72 "Structural study of ultra thin anodic silicon layers for nanoelectronic and photonic applications", **S. Gardelis, F. Petraki , S. Kennou, A. G. Nassiopoulou**

PI.73 "A Comparative Evaluation of De-Embedding Methods for on-wafer RF CMOS Inductor S-parameter Measurements", **Maria Drakaki, Alkis A. Hatzopoulos & Stylianos Siskos**

PI.74 "Simulation of the electrical characteristics of MOS capacitors on strained-Silicon substrates", **N. Kelaidis, D. Skarlatos & C. Tsamis**

Poster Session II - Tuesday 18^{00} - 21^{00}

Devices, Sensors and Microfluidics

P II.1 "Compact Current Modeling of Short-Channel Multiple Gate MOSFETs", **S. Kolberg, H. Børli, T. A. Fjeldly**

P II.2 "Macroporous silicon as bottom electrode in a high capacitance silicon microcapacitor", **A. Sancho, F.J. Gracia**

P II.3 "GAS management TROUGH MAcroPOROUS - MESOPOROUS SILICON BIIAYERS", **S. Desplobain, G. Gautier, L.Ventura and M. Roy**

P II.4 "Application of electrochemical impedance spectroscopy and equivalent circuit approach to the study of silicon DNA sensor", **V.I.Ogurtsov, M. Manning**

P II.5 "An Experimental Study of Band Gap States Electrical Properties in Poly-Si TFTs by the Analysis of the Transient Currents", **Loukas Michalas, Georgios J. Papaioannou, Dimitrios N. Kouvatsos, Apostolos T. Voutsas**

P II.6 "Optimization of DLC- Porous Silicon Antireflection Coating Proprieties for Multicrystalline Silicon Solar Cells", **K. Ait Hamouda[1], N. Gabouze, A. Ababou**

P II.7 "Realization of a magnetic field sensor with a porous silicon based structure for gas detection", **Y. OUADAH*, G. FORTAS, N. CHIBOUB, H. CHERAGA, N. GABOUZE**

P II.8 *"Ideality factor dependence of leakage current and reverse current noise of Au/n-GaAs Schottky diodes with embedded self-assembled InAs quantum dots",* **N. Arpatzanis, C. A. Dimitriadis, C. Charitidis, J. D. Song, W. J. Choi and J. I. Lee**

P II.9 "Charge trapping phenomena in high-efficiency metal-oxide-silicon light-emitting diodes with Tb ion implanted oxide", **Nazarov A., Osiyuk I., Tyagulskii I., Lysenko V., Prucnal S., Sun J., Yankov R., Skorupa W.**

P II.10 "Modified MIS-structure based on nanoporous silicon with enhanced sensitivity to hydrogen containing gases", **T.I. Gorbanyuk*, A.A. Evtukh, V.G. Litovchenko, V.S. Solntsev**

P II.11 "Spin-Transfer Torque in Double-Barrier Magnetic Tunnel Junctions", **Ioannis Theodonis, Alan Kalitsov, Nicholas Kioussis**

P II.12 "Current transport mechanisms for n-InSe/p-CdTe heterojunctions", **P.N. Gorley, Z.M. Grushka, O.G. Grushka, O.A. Chervinsky, P.P. Horley, Yu. V. Vorobiev, and J. González-Hernández**

P II.13 "The Study of ESD Induced Defects in Grounded Gate NMOS Using Low Frequency Noise Measurements", **J. Hadzi-Vukovic, M. Jevtic, M. Glavanovics, H. Rothleitner**

P II.14 "Readout integrated circuit for x-ray imaging with cdte pixel sensors", **Charalambos Lambropoulos, Emmanouel Zervakis, Dimitris Loukas**

P II.15 "p-SrCu2O2/n-Si diodes grown by pulsed laser deposition", **E.L. Papadopoulou*, D. Louloudakis, M. Varda, M. Kayambaki, M. Androulidaki, G. Huyberechts, E.**

Aperathitis

P II.16 "Investigation of top gate electrode variations for high-k gate dielectric MOS capacitors", **D.C. Moschou, E. Verelli, D.N. Kouvatsos, P. Normand, D. Tsoukalas, A. Speliotis, P. Bayiati, D Niarchos**

P II.17 "The effect of crystallization technology and gate insulator deposition method on the performance and reliability of polysilicon TFTs", **Despina C. Moschou, Giannis P. Kontogiannopoulos, Dimitrios N. Kouvatsos and Apostolos T. Voutsas**

P II.18 "Development of InN based heterostructures and nanostructures", **E. Iliopoulos[1], E. Dimakis, K. Tsagaraki, and A. Georgakilas**

P II.19 "Non-Melt Laser annealing of Plasma Implanted Boron for ultra-shallow junctions in Silicon", **A. Florakis[*], N. Misra, C. Grigoropoulos, D. Tsoukalas, K. Giannakopoulos, A. Halimaoui**

P II.20 "RF MEMS Dielectric Charging Effect Estimation due to 1MeV γ-Ray Photons Irradiation", **V G Theonas[*], G J Papaioannou, G Konstantinidis & J Papapolumerou**

P II.21 "Concurrent Electrothermal Experimental Analysis of RF-MEMS Switches for High Microwave Power Handling", **F. Coccetti, R. Plana**

P II.22 "Peculiarities of charge retention in nanodot NVM structures under the unipolar bias conditions", **V. Turchanikov*, A. Nazarov, V. Lysenko, V. Ievtukh, O.Winkler, M. Baus, B. Spangenberg, H. Kurz**

P II.23 "Performance of Thin-Film Transistors fabricated by Sequential Lateral Solidification crystallization techniques", **M.A. Exarchos, D.C. Moschou, G.J. Papaioannou, D.N. Kouvatsos, A.T. Voutsas**

P II.24 "Plasma nanostructuring of PDMS surfaces and its effect on protein adsorption", **Maria-Elena Vlachopoulou, Panagiota Petrou, S. Kakabakos, A.Tserepi, E.Gogolides**

P II.25 "Detection of CO and NO using low power Metal Oxide sensors", **R. Triantafyllopoulou, C. Tsamis**

P II.26 "A Comparison of Two Analogue Buffers, Implemented with Low Temperature Polysilicon Thin-Film Transistors, for Active Matrix Applications", **Ilias Pappas, Stilianos Siskos, Gerald Ghibaudo and Charalambos A. Dimitriadis**

P II.27 "A fully 2-dimensional, quantum mechanical calculation of short-channel and drain induced barrier lowering effects in HEMTs", **G. Krokidis, J. P. Xanthakis, N. Uzunoglu**

P II.28 "Hydrophobic plasma-deposited fluorocarbon films as a means for biofluid transport and selective adsorption of biomolecules on lab-on-a-chip devices", **P. Bayiati[*], A. Tserepi[**], P. S. Petrou, S. E. Kakabakos, E. Matrozos, D. Goustouridis, K. Misiakos, E. Gogolides**

P II.29 "A calculation of the current through the ZnO/ZnMgO/ZnO/ZnMgO/Zno double barrier system", **E.I. Sfakianakis, J.P. Xanthakis**

P II.30 "Modeling MOSFET Gate Length Variability for Future Technology Nodes", **G. P. Patsis**

P II.31 "Flexible Organic Light Emitting Diodes (OLEDs) based on blue emitting polymers", **M. Vasilopoulou[*], A. Botsialas, D. Georgiadou, L. Palilis, P. Bayiati, N. Vourdas, P. S. Petrou, G. Pistolis and P. Argitis**

P II.32 "Design To Improve The Capacitive Contact Quality in Piezoelectric Actuation", **H.ACHKAR, D.PEYROU, F.PENNEC, M.AL AHMAD, P.PONS, R.PLANA**

P II.33 "SiO2(Si) films as a medium for charge storage in memory devices", **A. Evtukh, O. Bratus', T. Gorbanyuk**

P II.34 "Hybrid polymer-inorganic solar cells based on polythiophene and phthalocyanine/polyoxometalate blends", **L. C. Palilis[*], A. M. Douvas, G. Chaidogiannos, M. Vasilopoulou, N. Glezos, S. Nespurek, P. Falaras, & P. Argitis**

P II.35 "Direct laser printing of biomolecules on capacitive sensors", **C. Boutopoulos, P. Andreakou, S. Chantzandroulis, D. Goustouridis, I. Zergioti, D. Kafetzopoulos & D. Tsoukalas**

P II.36 "Development of electrically-pumped microcavity lasers", **S. Tsintzos , Z. Hatzopoulos, P. G. Savvidis, N.T. Pelekanos**

P II.37 "Room Temperature Tunable Laser Diodes Using Stark Effect Gain Tuning", **G. Deligeorgis, Z. Hatzopoulos, S. Tsintzos and N.T. Pelekanos**

P II.38 "An all-organic optocoupler based on polymer light-emitting diodes (PLEDs)", **M. Vasilopoulou*, N. Stathopoulos, P. Falaras, G. Pistolis, D. Davazoglou and P. Argitis**

P II.38[A] "Photoresist material and process optimization for the patterning of biomolecules on functionalized surfaces", **P. Pavli, M. Chatzichristidi, A. M. Douvas, P. S. Petrou, S.E. Kakabakos, D. Dimotikali, P. Argitis**

Micro&Nano fabrication

P II.39 "Colloidal lithography: comparison between thermal evaporation and RF sputtering", **Ulmeanu M., Filipescu M., Medianu R.**

P II.40 "Dewetting of thin polymer films controlled by a simple energetic criterion", **I. Karapanagiotis**

P II.41 "Oxygen Plasma Development of Silylated Epoxydized photoresists for Micromachining Applications", **D.Kontziampasis, E. Gogolides**

P II.42 "VUV laser circular microstructured surface relief gratings induced on ptfema surface", **E. Sarantopoulou, Z. Kollia, A. C. Cefalas, A. M. Douvas, M. Chatzichristidi, P. Argitis**

P II.43 "The nanoscience of the alloy liquid metal ion sources and application in focused ion beams", **T. Ganetsos**

P II.44 "Dependence of the curvature of Si/Ge cantilevers on the size, composition, temperature", **N. Skoulidis*, H.M. Polatoglou**

P II.45 "Electron Beam Lithography Simulation Algorithm over Multilayer Substrates", **N. Tsikrikas, G. P. Patsis, I. Raptis**

P II.46 "Evaluation of polymers containing ketal or acetal groups in the backbone as candidate photoresist components", **T. Manouras, A. M. Douvas, V.P. Vidali, M. Chatzichristidi, N. Vourdas, E. Gogolides, E.A. Couladouros, P. Argitis**

P II.47 "Photoresist models for stochastic lithography", **D. Drygiannakis, G. P. Patsis, I. Raptis**

Design, Integration, Systems, Photonics

P II.48 "Thick microporous silicon isolation layers for integrated rf inductors", **J. Semai, G. Gautier, P. Leduc and L. Ventura**

P II.49 "SECS: A novel system for the design and simulation of single electron circuits", **G. T. Zardalidis**

P II.50 "Alpha Particle Radiation Effects in RF-MEMS Switches", **E. Papandreou, F. Giacomozi, G. J. Papaioannou and B. Margesin**

P II.51 "MEANDER: A CAD Tool Framework for Designing 2D/3D FPGAs", **K. Siozios, K. Sotiriadis, D. Soudris**

P II.52 "Studying compatibilities between quantum cellular automata and Kane's semiconductor based quantum computer", **D.Ntalaperas and N.Konofaos**

P II.53 "QDIP technology and market prospects in the sectors of Defense, Environment, and Security", **C. Charitidis*, A. Golnas, F. Chouliaras, N. Arpatzanis, C. A. Dimitriadis, J. I. Lee, C. Bakolias**

P II.54 "A thermal vacuum detector fabricated by a combination of MEMS and PCB technologies", **A. Petropoulos, G. Kaltsas, A. G. Nassiopoulou**

P II.55 "Fabrication and evaluation of a gas flow sensor, implemented on organic substrates by a novel integration technology", **A. Petropoulos, G. Kaltsas, A. G. Nassiopoulou**

P II.56 "Copper Wires in Macroporous Si Template for Microchannel Heat Sink Technology", **F. Zacharatos, A. G. Nassiopoulou**

P II.57 "Design and simulation of a CMUT array", **V. G. Chouvardas, M.K. Hatalis**

P II.58 "Design and simulation of a Micro-Mixer, based on MLG T-Flip-Flops and AC Electro-Osmosis", **T. Tsenis, V. G. Chouvardas, M.K. Hatalis**

P II.59 "Dielectric Characterization of Macroporous Silicon Thick Layers For Use As Capacitors In High Voltage Application", **M. Theodoropoulou, D. N. Pagonis, A. G. Nassiopoulou, C.**

A. Krontiras and S. N. Georga

P II.60 "Flexible WO3 based electrochromic displays using proton conducting solid electrolytes", **M. Vasilopoulou*, P. Argitis, G. Aspiotis, G. Papadimitropoulos,D. Davazoglou**

P II.61 "A real time development of an automatic fingerprint identification system using the AFS860 sensor and the C6713 DSP processor", **C. Tselios, E. N .Zois, N. A. Livanos, A. Nassiopoulos**

P II.62 "Energy Dissipation of Hot Electrons via Emission of Stretching Phonons in Semiconducting Carbon Nanotubes", **M. Tsaousidou**

SESSION 1: DEVICES

INVITED TALK I1

Si nanoelectronic devices for emerging CMOS and beyond

* Wei-Xin Ni[1,2,3], Jia-Min Shieh[1], and Horng-Chih Lin[1,2]

[1] National Nano Device Laboratories
26 Prosperity Road I, Hsinchu 30078, Taiwan, R.O.C
[2] Dept. of Electronic Engineering, National Ciao Tung University
1001 Ta-Hsueh Road, Hsinchu 30078, Taiwan, R.O.C
[3] Dept of physics, Linköping University
SE-581-83 Linköping, Sweden,

With the advance of fabrication techniques, integrated circuits (IC) industries have been merged into the nano-technology realm, and according to the time table the 45 nm chip commercial production will be released in the 4th quarter of 2007. It is evident that Si as the backbone material for IC electronics will keep going for quite some years, and continue to give power to the world economy. The issue is how to further pursue the race? Every body knows there must be an end for the size competition, since the separation between the source and drain can't be zero. Therefore, as a trend and also the vision of industries, the chip production would not only go further for structural miniaturization (more Moore), but also extend the chip functionalities (more than Moore) to involve various novel device architectures using on-chip or off-chip integration solutions for a new generation of electronics systems with high added values for the end customers. This thus requires interdisciplinary and diversification of knowledge, in particular challenges materials science for new material systems that are designed and engineered through nanotechnology.
In this talk, I will give a survey and also recent efforts at National Nano Device Laboratories (NDL) for Si-based devices and architectures that maybe implemented along the roads toward 22 nm-node CMOS and beyond for more and more than Moore, in particular, to deal with some device solutions using Ge or III-V semiconductors for enhancing performance and functionalities, and issues relating to so-called heterogeneous integration of these devices with the existing Si chip systems. It is noted that for nano-sized p-MOS, Ge channel might be a good solution, but for n-MOS there are server limits even considering the implementation of some III-V semiconductors as the channel materials. Furthermore, some routes to integrate functional devices for electronic-photonic convergence and bio-electronic applications will also be discussed.

INVITED TALK I5

Micro and Nano on Insulator

Sorin Cristoloveanu

Institute of Microelectronics, Electromagnetism and Photonics (IMEP, UMR 5130)
INP Grenoble Minatec, 3 Parvis L. Néel, BP 257, 38016 Grenoble Cedex 1, France

The nano-size MOS transistor is the ideal device for the smooth transition from micro- to nano-electronics, the stringent condition being to be fabricated 'On Insulator'. Without SOI, the future of the microelectronics and CMOS technology would be hopeless. SOI means *Semiconductor* On Insulator, it comprises any kind of ultra-thin semiconductor layer, strained or not, on any type of dielectric. It is the SOI thickness effect which renders the scaling of MOS transistors intrinsically easier than in bulk Si, where it is becoming a desperate issue. In addition, SOI is a most suitable substrate for the implementation of non-classic or pure nanoelectronic components.
The dimensions of state-of-the-art SOI MOSFETs are already measurable in nanometers. The aim of this presentation is to illustrate, from an experimental viewpoint, a number of nano-size mechanisms and implications. The scaling beyond 10-nm channel-length is discussed by addressing the main effects. A key aspect is that all dimensions need to be reduced concomitantly, not separately. An ultimate SOI MOSFET should be viewed and modelled as a transistor with a miniaturized volume. The impact of strain, channel orientation and film thickness on the carrier mobility will be illustrated. Finally, the 3-D scaling of the transistor volume will naturally lead to the discussion of multiple gate MOSFETs, such as double-gate, triple-gate, gate-all-around, and four-gate transistors.

ABSTRACT: MN178

Electrical characterization of InAs-nanocrystal-based nonvolatile memories

Moïra Hocevar, Philippe Regreny, Michel Gendry, Abdelkader Souifi

Institut des Nanotechnologies de Lyon-INL, UMR-CNRS-5270, INSA de Lyon, 7 avenue Jean Capelle, 69621 Villeurbanne Cedex, France, moira.hocevar@insa-lyon.fr

The development of highly integrated nonvolatile memory (NVM) devices has led to the use of Si or Ge nanocrystals (NCs) embedded in the SiO_2 gate oxide of metal-oxide-semiconductor (MOS) structures instead of conventional polycristalline silicon floating gates [1-2]. In order to improve data retention, Si and Ge could be replaced by InAs due to its smaller energy gap. Moreover, the smaller carrier effective mass in InAs allows a better separation of the electronic levels in the nanocrystals, making it attractive for multibit storage. In this context, we propose to fabricate and characterize MOS structures containing InAs NCs and intended to integrate a memory cell (Fig. 1).

InAs NCs were grown by molecular beam epitaxy directly on the SiO_2 tunnel layer and then capped with a SiO_2 control layer. In such architectures (Fig. 2), the tunnel and the control oxide thicknesses are very well controlled such as both InAs NCs density and size [3]. Aluminum gates were deposited for electrical characterizations of InAs NCs based MOS structures.

The study of the charge carrier retention in NCs has been achieved using capacitance-voltage (*C-V*) measurements. Positive and negative biases have been applied to the gate during 30 s. The flat-band shift is negative for negative bias applied to the gate and positive when the bias is positive (Figure 3). Thus, we conclude about a hole tunneling from the substrate towards the NCs in accumulation conditions and electron tunneling in inversion conditions.

The retention time has been determined using capacitance-time *(C-t)* measurements. The discharge kinetics is very slow, which demonstrate a very good retention time for holes and electrons. Moreover, the retention time for electrons is better in InAs than in Si and in Ge [4], which was confirmed by calculations (Figure 4). We assume that it is mainly due to the higher conduction band offset between InAs and SiO_2.

In conclusion, we have shown that it is possible to store both electrons and holes in the InAs NCs. Moreover the retention behavior is very good, especially for the electrons comparing with Si NCs and Ge NCs based NVM.

[1] S. Tiwari *et al.,* Appl. Phys. Lett. 68 (1996) 1377.
[2] B. De Salvo *et al.,* IEDM Tech. Dig. (2003) 597.
[3] M. Hocevar *et al.,* submitted to Appl. Phys. Lett. (2007).
[4] M. Kanoun *et al.,* Appl. Phys. Lett. 84 (2004) 5079.

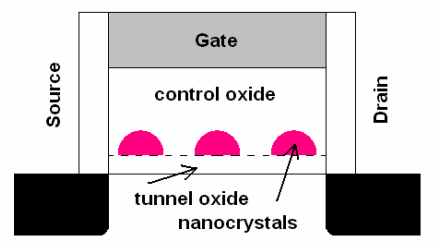


Figure 1: Schematic cross-section of the nanocrystal-based memory element designed by Tiwari *et al.*[1].

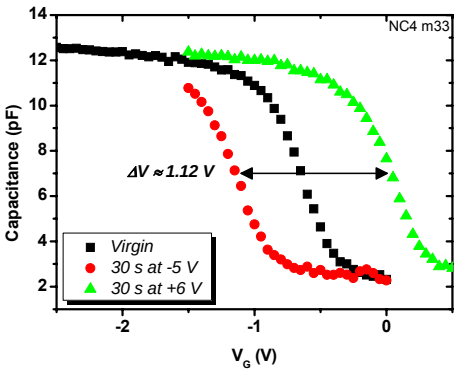


Figure 3: Comparison of typical high-frequency C-V characteristics (100 kHz) for a device containing InAs NCs. The surface of the MOS capacitor is 70 × 70 μm^2.

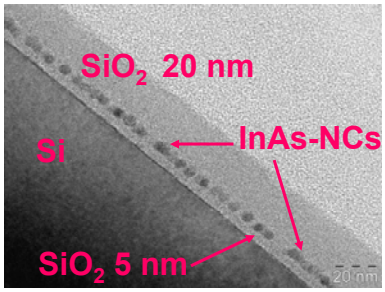


Figure 2: Shows a cross-sectional lattice-imaged transmission-electron micrograph of InAs nanocrystals embedded in a matrix of SiO_2.

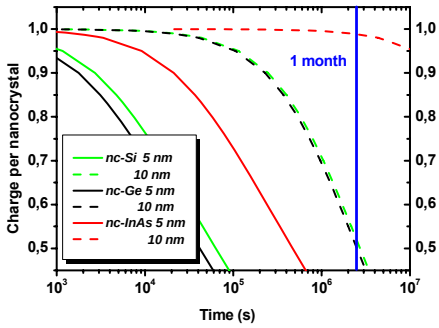


Figure 4: Calculation of electron retention in InAs NCs, Ge NCs and Si NCs. The tunnel SiO_2 is 3.5 nm-thick, the NCs diameter is 5 nm and 10 nm.

ABSTRACT: MN27

Semi-analytical modelling of short channel effects in sub-50 nm Si symmetrical gate-all-around MOSFETs

A. Tsormpatzoglou[1], C. A. Dimitriadis[1], R. Clerc[2], Q. Rafhay[2], G. Pananakakis[2], and G. Ghibaudo[2]

[1] Department of Physics, Aristotle University of Thessaloniki, 54124 Thessaloniki, Greece,
e-mail: cdimitri@skiathos.physics.auth.gr
[2] IMEP, MINATEC, Parvis Louis Néel, 38054 Grenoble Cedex 9, France

A simple analytical expression of the three-dimensional potential distribution along the channel of sub-50 nm silicon symmetrical gate-all-around (GAA) MOSFETs is derived in weak inversion. The analytical solution of the potential distribution is compared with the numerical solution of the three-dimensional Poisson's equation along the channel direction. The obtained results show that the analytical solution describes with good accuracy the potential distribution along the channel at different positions within the volume of the channel material, except at the edges of the channel where a small deviation of the model from the simulated results is observed close to the source and drain regions. Based on the three-dimensional extra potential induced in the silicon film due to short channel effects, the subthreshold drain current of short channel devices is determined. From the obtained subthreshold characteristics, the subthreshold slope, drain-induced barrier lowering and threshold voltage of GAA MOSFETs are extracted, which are compared with those of double-gate and tri-gate MOSFETs. The results show that the short-channel effects are minimized using the 4-gate structure.

SESSION 2: LIGHT EMITTING MATERIALS AND DEVICES

INVITED TALK I3

Growth of III-Nitride quantum dots and their applications to blue-green LEDs

Theodore D. Moustakas, Tao Xu, Alexey Nikiforov and Christos Thomidis

Department of Electrical and Computer Engineering, Center of Photonics Research, Boston University, 8 Saint Mary's Street, Boston MA 02215, USA, Moustakas@bu.edu

LEDs emitting in the violet-blue-green are based on InGaN multiple quantum wells (MQWs). The internal quantum efficiency of such devices decreases as the InN mole fraction in InGaN increases, a result whose origin has not been fully understood. Spinodal decomposition driven phase separation leads to compositional inhomogeneities and the resulting potential fluctuations have been thought to be beneficial to emission by LEDs due to localization of excitons. However, InGaN alloys were also found to undergo partial atomic ordering, and this phenomenon was thought to be undesirable to LED performance because electron-hole pairs tend to separate in the ordered and random domains and thus minimizing the efficiency of spontaneous radiative recombination. An alternative approach is to use III-Nitride quantum dots as the active region of such LEDs, where the exciton localization occurs by the quantum confinement, and phase separation and partial atomic ordering are not likely to occur due to the small size of the QDs. In this talk we discuss the growth of InN, GaN and InGaN QDs by MBE on either GaN or AlN templates. InN QDs on GaN templates were found to occur without an InN wetting layer, a result consistent with the large lattice mismatch of 11% between InN and GaN. Self-assembled GaN QDs were grown on AlN templates using the Stranski-Krastanov mode of growth. The microstructure and the size distribution of such QDs in a single layer or a superlattice structure will be discussed. Finally, the self assembly of InGaN QDs on GaN templates using the Stranski-Krastanov mode and the applications of such QDs to blue-green-red LEDs will be discussed. The results indicate that InGaN / GaN MQDs are highly strained and their emission at low injection is red shifted with respect to that of a single layer of QDs due to quantum confined Stark effect.

ABSTRACT: MN149

GaN epitaxy on γ-$LiAlO_2$(100) substrates

A. Mogilatenko[1], W. Neumann[1], E. Richter[2], M. Weyers[2], B. Velickov[3], R. Uecker[3]

[1]Institut für Physik, Humboldt-Universität zu Berlin, Newtonstr. 15, 12489 Berlin, Germany, e-mail: anmog@physik.hu-berlin.de, [2]Ferdinand-Braun-Institut für Höchstfrequenztechnik, Gustav-Kirchhoff-Str. 4, 12489 Berlin, Germany, [3] Institut für Kristallzüchtung, Max-Born-Str. 2, 12489 Berlin, Germany

In the last years (100)γ-$LiAlO_2$ has been investigated as an alternative substrate for the GaN epitaxy. Its main advantage compared to the commonly used sapphire substrates is the possibility to grow GaN layers in a non-polar $[1\bar{1}.0]$ direction. These so-called m-plane oriented GaN layers show absence of internal polarisation fields along the growth direction which is advantageous for fabrication of optoelectronic devices with high performance. Furthermore, growth of GaN layers in the polar [00.1] growth direction (c-plane oriented layers) is also possible on (100)γ-$LiAlO_2$. A further distinct feature of the GaN/$LiAlO_2$ system is a spontaneous separation of the substrate from thick GaN films during post-growth cooling down, which is caused by $LiAlO_2$ decomposition at elevated growth temperatures. This allows the preparation of thick freestanding GaN layers, which can be utilized as substrates for subsequent GaN homoepitaxy.

The present study will report on structural characterisation of c-plane oriented GaN layers grown on (100)γ-$LiAlO_2$ by hydride vapour phase epitaxy and m-plane oriented GaN layers grown by metalorganic vapour phase epitaxy. Despite a relatively small lattice mismatch between the (100)$LiAlO_2$ face and the $(1\bar{1}00)$GaN as well as the (0001)GaN growth planes, the films of both orientations still contain a large number of defects. The defect structure of the obtained layers has been analysed by transmission electron microscopy. The most dominant defects are stacking faults for the m-plane GaN films and threading dislocations for the c-plane GaN layers. Furthermore, freestanding thick c-plane oriented GaN layers show the presence of GaN regions, which appear brown in colour in the colourless GaN matrix and have a pyramidal shape. These regions contain v-pits. The origin of the formation of brown GaN pyramids will be discussed in this study.

ABSTRACT: MN129

Single dot spectroscopy on InAs/GaAs piezoelectric quantum dots

G. E. Dialynas[1], C. Xenogianni[1,2], S. Tsintzos[1,2], P. G. Savvidis[1,2], G. Constantinidis[1], Z. Hatzopoulos[1,3], N. T. Pelekanos[1,2,*]

[1]Microelectronics Research Group, IESL/FORTH , P.O.Box 1527, 71110 Heraklion Crete , Greece, [2]Materials Science and Technology Department, University of Crete, P.O.Box 2208, 71003 , Heraklion, Crete, Greece, [3]Physics Department, University of Crete, P.O.Box 2208, 71003 Heraklion, Crete, Greece.
* Corresponding author: pelekano@materials.uoc.gr

The optical signature of few-particle complexes (excitons, biexcitons, trions) in quantum dot (QD) systems has received recently a lot of attention, in view of novel interesting applications in quantum cryptography and photon entanglement. In conventional (100) InAs QDs, the biexcitonic lines are typically a few meV below or above the excitonic ones, depending on the shape and In profile of the dots. Here, we present clear evidence of large negative biexciton binding energies E_{XX} in InAs QDs grown by MBE on (211) B GaAs substrates, as a consequence of the ~200-300kV/cm piezoelectric (PZ) field present in these dots along the growth axis. The samples consist of a single InAs QD layer, with dot heights varying from 2 to 8nm and an aspect ratio of 10, capped by a 30nm GaAs layer. The QD photoluminescence (PL) is centered at 1.25eV, and has a relatively narrow linewidth of 100meV.

Micro-PL spectra from single QDs were recorded at low temperatures through 300nm apertures, using a cw He-Cd laser at 325nm as the excitation source. A typical micro-PL spectrum consists of two main sharp peaks which exhibit drastically different power dependence. The low-energy (X) peak increases linearly with power and is due to excitonic emission, whereas the high energy (XX) peak increases quadratically and is attributed to biexcitonic emission from a single QD. The fact that the XX peak is ~6- 9meV higher in energy than X implies that E_{XX} is strongly negative in these QDs, most likely due to the existence of the PZ field. Theoretical calculations reveal that, due to the PZ field, the electron-electron and hole-hole Coulomb repulsive terms exceed the electron-hole attraction, giving rise to a negative E_{XX}. Additionally, E_{XX} exhibits a non-monotonic dependence on QD size, which can be understood including exchange interaction effects. Ongoing work focuses on studying the QD emission spectrum under an external electric field.

ABSTRACT: MN63

Nanoscale Structure of GaN Nanowires Grown on Various Substrates

Th. Kehagias[1,*], Ph. Komninou[1], G.P. Dimitrakopulos[1], C. Chèze[2], L. Geelhaar[2], H. Riechert[2], H. Kirmse[3], W. Neumann[3], and Th. Karakostas[1]

[1] Physics Department, Aristotle University of Thessaloniki, GR-54124 Thessaloniki, Greece, *e-mail: kehagias@auth.gr, [2] Qimonda, D-81730 Munich, and NaMLab, D-01099 Dresden, Germany, [3] Humboldt-Universität zu Berlin, Institut für Physik, AG Kristallographie, Newtonstraße 15, D-12489 Berlin, Germany

One-dimensional nanostructures, such as nanowires (NWs) are promising materials for photonics applications, due to their excellent optical, electronic and mechanical properties. The variety of semiconductor NW optical and electronic devices includes transistors, logical gates, photo detectors, LEDs and lasers. NW growth by bottom-up techniques is usually based on the vapor-liquid-solid (VLS) mechanism, by means of evaporation or sputtering of a catalytic metallic layer (Au, Ni, Fe) on the surface of the substrate. In this study, we report on the structural properties of GaN NWs at the nanoscale, employing conventional and high resolution transmission electron microscopy (TEM-HRTEM). NWs were grown with or without a catalytic layer on Al_2O_3(0001), Si(111) and Si(100) by molecular beam epitaxy (MBE).

GaN NWs were axially grown on Al_2O_3(0001) only in the presence of a Ni catalyst layer on the surface of Al_2O_3 and exclusively under N-rich conditions. When the V/III-ratio was switched from N-rich to Ga-rich conditions, after NWs had been initially formed, growth proceeded almost exclusively in radial direction, thus thickening of the NWs was observed. Electron microscopy observations showed the single crystalline nature of the NWs, which exhibited the wurtzite structure. Several basal stacking faults that are present in the NWs introduce successive sphalerite atomic layers. Single crystalline catalyst seeds are usually observed on the tips of the NWs, suggesting a VLS type of growth.

NWs grown on both Si(111) and Si(100) showed no significant structural differences when grown in the presence of a catalytic metallic layer or not. Actually, it was observed that NWs were not grown at all in areas where Ni seeds were located. The crystal quality of GaN in these NWs is superior to that of NWs on Al_2O_3, although their relative orientation with the Si substrate is within $\pm 10^o$ about the axial direction. Moreover, an amorphous SiN_x layer is systematically observed at the NW/substrate interface in both cases.

Acknowledgement: This work was supported by EU Marie Curie RTN contract MRTN-CT-2004-005583 (PARSEM).

SESSION 3: MICRO AND NANO FABRICATION I

INVITED TALK I4

Nanoimprint lithography and surface modification as prospective technologies for heterogeneous integration

N. Kehagias[1], W. Hu[2], V. Reboud[1], N. Lun[2], L. Chi[2,3], H. Fuchs[3], A. Genua[1], J. A, Alduncín[4], J. A. Pomposo[4], D. Mecerreyes[4], R. Farrell[5] and C. M. Sotomayor Torres[1,6]

[1] Tyndall National Institute, University College Cork, Lee Maltings, Cork, Ireland
[2] Key Laboratory for Supramolecular Structure and Materials, Jilin University, 130012, Changchun, P. R. China..
[3] Physikalisches Institut and Center for Nanotechnology (CeNTech), Westfälische Wilhelms-Universität, D-48149 Münster, Germany.
[4] New Materials Depart., Centre for Electroch. Technol., San Sebastian Technol. Park, Donostia-San Sebastián 20009, Spain
[5] Centre for Research on Adaptive Nanostructures and Nanodevices (CRANN), Ireland
[6] Catalan Institute of Nanotechnology, Campus de Bellaterra, Edifici CM7, ES 08193 - Bellaterra, Spain and Catalan Institute for Research and Advanced Studies ICREA, 08010 Barcelona, Spain.Email: clivia.sotomayor@tyndall.ie

Nanoimprint lithography (NIL) offers the possibility to pattern wafer-scale surfaces with nm-sized structures in polymers reaching the 10 nm lateral size. Printable polymers can be tailored to have a surface upon which molecules self-assemble. Furthermore, the resulting surfaces may be heterogeneously structured with or without etching away parts of imprinted polymers, in order to provide a flexible platform for structured surfaces with functional materials.

We review progress in these combined approaches and discuss three examples:

- A concept to realise patterned surfaces with different emission colours by using a one-step gas phase deposition of a single type of molecules on pre-patterned solid substrates.
- A process to modify printed surfaces in order to grow polymer brushes.
- An alternative method for inducing 3D ordering in block copolymer lamellae films on printed surfaces.

The support of the EC-funded projects NaPa (Contract No. NMP4-CT-2003-500120) and PHOREMOST (FP6/2003/IST/2-511616), of Science Foundation Ireland and of the Royal Irish Academy is gratefully acknowledged. The content of this work is the sole responsibility of the authors.

ABSTRACT: MN172

Nanopatterning the Si Surface Through Porous Anodic Alumina Masking Layers

F. Zacharatos, V. Gianneta and A. G. Nassiopoulou

IMEL/NCSR Demokritos, P.O. Box 60228, 15310 Athens, Greece

Anodic porous alumina thin films on Si, fabricated by electrochemical oxidation of Al films, show cylindrical vertical pores, arranged in a hexagonal close - packed, of size and density that are tunable by changing the electrochemical conditions used. These films are used as masking layers for nanopatterning the Si surface through the pores, using different techniques: a) By electrochemical oxidation of the Si surface through the pores, regular arrays of SiO_2 dots may be fabricated, that can be chemically removed to leave a bare Si surface with pits at each pore tip. b) By porosification of the Si surface through the pores and porous Si removal, deeper pits on Si are fabricated. c) V-grooves in the form of inverted pyramids are fabricated at each pore tip, which are then used as pore initiation pits for the fabrication of regular macropores with mean diameter in the order of 300nm and other photonic structures. In this work, the above processes will be described and interesting fabricated photonic structures will be shown.

ABSTRACT: MN92

Three-dimensional quasi-regular Ni nanostructure-array in a porous silicon membrane correlated with magnetic characteristics

P. Granitzer[1], K. Rumpf[1], P. Pölt[2], S. Šimić[2], H. Krenn[1]

[1] Institute of Physics, Karl Franzens University Graz, Unversitaetsplatz 5, 8010 Graz, Austria, email: klemens.rumpf@uni-graz.at, [2] Institute for Electron Microscopy, University of Technology Graz, Steyrergasse 17, 8010 Graz, Austria

Self-assembled porous media with a quasi-regular structure offer the possibility to arrange nanoparticles/nanowires in three dimensions. The regular pore-patterns of the matrix can be achieved in a certain regime, ranging between pore-diameters of 40 nm up to 100 nm using the same doping density of the silicon substrate. In this range the precondition of the pore-distance being less than twice the space charge region is fulfilled to obtain rather regular aligned and separated channels. Furthermore the formation of a double-sided porous layer with a thickness of 30 µm of each side was obtained. These porous silicon membranes with rather regular pore-arrangements, even fabricated double-sided, are filled with Ni during electrolytic deposition. The precipitation is performed in using a metal salt solution which is reduced in a cathodic process. The achieved nanocomposite can be varied on the one hand by modification of the nano-architecture of the silicon template and on the other hand by altering the metal deposition process. Structural characterization of the template as well as of the deposited metal-particles is performed by scanning electron microscopy, especially in recording the back scattered electrons and EDX-mapping, respectively to get element sensitive information. Different templates exhibiting various pore-arrangements and different Ni-loadings with structures of distinct shape (spheres up to wires) show specific magnetic properties. Thus a relationship between the structure and magnetic characteristics is figured out.

ABSTRACT: MN174

Selective Photochemical Etching of GaN Films Following Laser Lift-off

Trichas Emmanouil[1,2], Xenogianni Christina[1,2], Kayambaki Maria[2], Iliopoulos Eleftherios[2], Savvidis Pavlos[1,2], Pelekanos Nikos[1,2]

[1]Department of Materials Science & Technology, University of Crete, Heraklion 71110, Crete, Greece, [2]Microelectronics Research Group , FORTH/IESL, Physics dpt. Building, Heraklion 71110, Crete , Greece, e-mail: mtrichas@materials.uoc.gr

In the recent years, fabrication of GaN microcavities has been a topic of active research. This is mainly because GaN based microcavity structures are expected to exhibit strong coupling at room temperatures, and are thus excellent candidates for demonstration of room temperature polariton amplification, parametric oscillation and polariton lasing. Despite an enormous progress in the growth of monolithic structures by MBE techniques, the quality of the grown material is not yet satisfactory, not mentioning fundamental limitations posed by the material itself for fabrication of DBR mirrors.

In this report, we propose a new approach for fabricating GaN based microcavities. Two crucial steps required for fabrication of such structures are laser lift-off of GaN/ Al_xGaN films from their sapphire substrates and subsequent thinning of GaN film by selective photochemical etching.

Backside illumination with excimer laser pulses 193nm is used to separate the GaN film from its sapphire substrate by melting thin GaN layer adjacent to sapphire substrate followed by heating of the sample at 60^oC to lift the 2μm thick GaN membrane. ontrol of GaN membrane thickness to achieve the desired cavity size is crucial in microcavity fabrication and is performed by selective photochemical etching. The etch rate depends on the density of photogenerated carriers which strongly depends on the bandgap of the material. Selectivity in the etching process is achieved when using GaN/ Al_xGaN heterostructure based on the difference in the bandgap of GaN (3.44 eV) and Al_xGaN (>3.53 eV for x>5%) at room temperature. Illumination of the structure with a Xe lamp using specially designed filters below the bandgap of Al_xGaN in aqueous KOH solution ~0.01M ensures the selectivity in the etching process. In this technique we focus on self-stopping onto the first GaN/AlGaN interface in order to control the thickness of GaN/ Al_xGaN heterostructure. Monitoring photocurrent versus time through the whole etching process reveals the stop selective nature of the photochemical etching.

References:

1. M. Saba, et.al ,Nature 414, 731 (2001)
2. P. Visconti, et al, J. Vac. Sci. Technol. B 19.4., Jul/Aug 2001
3. W. S. Wong, et al, Appl. Phys. Lett. 72 (5), 2 February 1998

ABSTRACT: MN82

Growth and characterization of $In_xAl_{1-x}N$/GaN heterostructures, throughout the whole composition range, by plasma-assisted MBE

A. Adikimenakis*, E. Iliopoulos, G. Tsiakatouras, K. Tsagaraki, and A. Georgakilas

Microelectronics Research Group (MRG), Institute of Electronic Structure and Laser (IESL), Foundation for Research and Technology-Hellas (FORTH), P.O. Box 1527, 71110 Heraklion Crete, Greece; and Physics department, University of Crete, Heraklion Crete, Greece, *E-mail: adam@physics.uoc.gr

InAlN ternary thin film alloys with InN contents spanning the entire composition range were grown on GaN/Al_2O_3 and AlN/Al_2O_3 MOVPE templates by plasma-assisted Molecular Beam Epitaxy. Their morphological, structural, and electrical properties have been studied, as a function of the alloy composition. The growth kinetics of InAlN were studied and the indium incorporation in InAlN thin film growth was found to depend on both the substrate temperature and the available incident active nitrogen flux. Thus, a strategy was developed for the successful growth of InAlN alloys in the entire composition range. Surface morphology, as revealed by optical microscope and AFM, showed no dependence of the surface characteristics on the alloy composition. RMS surface roughness was kept as low as 1-2 nm for InAlN thin films with thicknesses of 300-500 nm. Structural characterization was performed by high resolution X-ray diffraction on both the (0002) symmetric and the (11-24) asymmetric reflections. The crystalline quality was evaluated and analyzed as a function of the composition of the alloy and the results are also discussed in terms of screw and edge type threading dislocation densities in the films. The best crystalline quality was observed for InAlN thin films grown lattice matched to GaN. Finally, the electrical characteristics revealed that the InAlN alloys grown by RF MBE are highly resistive and thus no 2DEG can be seen at the InAlN/GaN heterointerface.

SESSION 4: SENSORS AND MEMS

INVITED TALK I5

RF MEMS: Status and Perspectives

Fabio Coccetti, David Peyrou, Mahmoud Al Ahmad, Vincent Puyal, Patrick Pons, Hervé Aubert and Robert Plana

LAAS-CNRS and Toulouse University, 7 avenue du colonel roche, 31077 Toulouse cedex04, email :plana@laas.fr

The key challenges for the next generation of communication architectures are related to their ability to modify their properties in order to fit with different applications and environmental conditions. This is referred to a new class of miniaturized systems called "smart systems". RF MEMS technologies are considered as a very attractive enabler for smart miniaturized systems. This paper will outline the main characteristics exhibited by RF MEMS technologies as well as the main technological process flow (bulk micromachining, surface micromachining), the design and modeling methodologies that have to be implemented in order to meet the multi-physics and multi-scale behavior that are encountered. The paper will continue with a presentation of a panel of devices that have been already demonstrated and by some devices that could be envisioned in the future. Finally, the paper will finish with some key issues exhibited by RF MEMS represented by reliability issues, packaging at devices, circuit and system level in order to emphasize the future applications where smart systems will emerge.

ABSTRACT: MN140

A CHEMOCAPACITIVE SENSOR ARRAY SYSTEM FOR DETECTION OF COMPLEX ODORS

S.Dimopoulos, M. Kitsara, D. Goustouridis, I. Raptis, S. Chatzandroulis

NCSR "Demokritos", Institute of Microelectronics
15310, Athens, GREECE, stavros@imel.demokritos.gr

Arrays of chemical sensors have often been used as electronic noses for the detection of complex odors in the food industry [1-2], environment monitoring [3-4] and elsewhere. In such a system the sensor array is linked with an electronic interface, to convert the signal into the electrical domain, while special pattern recognition algorithms undertake the task of identifying odors and aromas.

In the present work we present a capacitive array of interdigital electrode chemical sensors with an electronic interface which converts capacitance changes into digital signal. The interdigital electrode chemical sensors are fabricated by covering the electrodes with a polymer layer [5]. The transduction then relies on the permittivity changes and swelling of the covering polymer, to inflict a change in the capacitance between the two electrodes structure. In our work an array of four sensors was fabricated using a recently developed methodology [6] based on the photolithographic deposition of four different polymer layers onto predefined interdigital Al electrodes (300nm thick, with 5μm finger spacing) deposited on a glass substrate.

The whole system was tested under different concentrations (2000, 5000, 10000 and 1000 ppm) of water and ethanol vapors. The IDC sensors in the array were covered with PHEMA, PDMS and PMMA polymer layers. The capacitance of each IDC sensor in nitrogen was ~45pF. Due to the absorption of the vapors and the swelling of the polymer film the response of the system is higher in the case of water vapors due to its high dielectric constant (ε~80).

The system will continue to be developed towards an electronic nose by expanding the array to eight sensitive polymer layers while processing on the PC will be expanded to allow for identification of odor patterns.

REFERENCES:

[1] A.M. Descalzo, L. Rossetti, G. Grigioni, M. Irurueta, A.M. Sancho, J. Carrete, N.A. Pensel, "Antioxidant status and odour profile in fresh beef from pasture or grain-fed cattle", *Meat Science*, vol. 75, pp. 299-307, 2007

[2] A. Hernández Gómez, G. Hu, J. Wang A. G. Pereira, "Evaluation of tomato maturity by electronic nose", *Comput. Electron. Arg.*, vol. 54, pp. 44-52, 2006

[3] G. Onkal-Engin, I. Demir and S.N. Engin, "Determination of the relationship between sewage odour and BOD by neural networks", *Environ. Modell. Softw.*, vol. 20, pp. 843-850, 2005

[4] J. Nicolas, A-C. Romain, V. Wiertz, J. Maternova Ph. André, "Using the classification model of an electronic nose to assign unknown malodours to environmental sources and to monitor them continuously", *Sens. Act B*, vol. 69, pp. 366-371, 2000

[5] R. Igreja, C.J. Dias, "Analytical evaluation of the interdigital electrodes capacitance for a multi-layered structure", *Sens. Act. A*. vol. 112, pp. 291-301, 2004

[6] M.Kitsara, D.Goustouridis, S.Chatzandroulis, M.Chatzichristidi, I.Raptis, Th.Ganetsos, R.Igreja, C.J.Dias, "Single Chip Interdigitated Electrode Capacitive Chemical Sensor Arrays", *Proc. Eurosensors XX*, Sweden, 17-20, 2006, vol.1, pp. 388-389

ABSTRACT: MN119

MEMS Composite Porous Silicon/Polysilicon Cantilevers for Biosensing Applications

S. Stolyarova[1], R.E. Fernandez[2], A. Chadha[3], E. Bhattacharya[2] and Y. Nemirovsky

[1]Solid State Institute, Technion-Israel Institute of Technology, Haifa, 32000, Israel,
ssstolya@tx.technion.ac.il
[2] Department of Electrical Engineering and [3]Department of Biotechnology,
Indian Institute of Technology Madras, Chennai 600036, India

We report new composite porous silicon/polysilicon microcantilevers made by combination of surface micromachining and vapor phase etching. Porous silicon (PS) is a unique material for immobilization of biomolecules due to a huge fractal surface area within a small volume [1]. The formation of PS layer on cantilever surface is expected to enhance the sensitivity of the cantilevers in biosensing applications. The current work focuses on the development of technology for fabrication of composite porous silicon/polysilicon microcantilevers and characterization of their morphology.
The oxide anchored cantilever beams of length 200 μm, width 10 μm and thickness 2 μm (Fig.1a). were fabricated by surface micromachining of n-type polysilicon grown by Low Pressure Chemical Vapor Deposition. A new solution for the formation of porous layer on polysillicon cantilevers after release was found by applying a novel technique: Reaction Induced Vapor Phase Stain Etch (RIVPSE) [2]. The apparent simplicity of this process, especially since there is no need of electrical contacts and immersion in electrolyte, makes this method extremely attractive for micromachining applications.
For short etching periods (10sec), a uniform nanostructured surface morphology with regular round pores of 5-7 nm is formed. For the longer etching times, the porous polysilicon layer shows a dual macro and nanostructure. The macrostructure reflects the condensation of drops while the nanostructure originates from the local reactions of vapor molecules with silicon resulting in nanoscale morphology. The morphology of porous layer on polysilicon was compared to that on crystalline silicon.

References

1. S. Stolyarova, E. Saridakis, N. Chayen, and Y. Nemirovsky, Biophysical Journal, 91, 3863(2006).
2. E. A. de Vasconcelos , J. A. K. Freire , V. N. Freire , B. E. C. A. dos Santos, W. M. de Azevedo and E. F. da Silva, Jr, phys.stat.sol (c) 1, S289 (2004).

ABSTRACT: MN152

Fuel cell electrodes on the basis of porous silicon

Vitali V. Starkov

Institute of Technology and High Purity Materials, RAS, Institutskaya str. 6, Chernogolovka 142432, Russia, e-mail: starka@ipmt.ru

Fuel cells are electrochemical devices that convert chemical energy of a fuel directly into electricity. Micro fuel cells (μFCs), which can be fabricated with micro- and nano-technologies, have nano and microstructures and generally generate less than 10 W of electricity, are the recent focus of the fuel cell research community.
Currently, there are two basic design approaches for delivery of fuel and oxidant in micro fuel cells: the traditional bipolar design and the planar design. Most micro fuel cells based on the bipolar design have separated fuel/oxidant delivery systems. Fuel and oxidant supply are separated by the proton exchange membrane (PEM). These fuel cells mostly used Nafion as the PEM. However, Nafion-based PEMs do not integrate easily with standard micro- and nano-technologies and their volumetric variations due to hydration are a real problem for their assembly with silicon substrates. Alternative system on the basis of polyvinyl spirit (PVS) and phenolsulfonic acid (PSA) have been proposed to avoid these problems.
The aim of work is the research and development of μFCs electrodes on the basis of porous silicon and PVS/PSA electrolyte. The results of use macroporous silicon in μFC structure are submitted.

ABSTRACT: MN95

System integration via development of chip embedding technologies in rigid and flex printed circuit boards

Dionysios Manessis[1], Andreas Ostmann[1], Thomas Loeher[2], and Herbert Reichl[1]

[1]Fraunhofer Institute for Reliability and Microintegration (IZM)
[2] Microperipheric Research Center, Technical University of Berlin (TUB)
Gustav-Meyer-Allee 25, 13355 Berlin, Germany, E-Mail: manessis@izm.fhg.de, Tel: +49-30-46403 788

The paper describes technologies for the realization of packages and System-in-Packages with embedded components. Embedding of semiconductor chips into organic substrates using a lamination technology has several advantages. At first it allows a very high degree of miniaturization and integration, since multiple layers of embedded components can be sequentially stacked. A further advantage is the beneficial electrical performance by short and geometrically well controlled interconnects.
In this paper the development of different technologies for component embedding will be described. One technology, called "Chip-in-Polymer", uses thin chips (25µm-50µm) which are die bonded and subsequently embedded by lamination of Resin Coated Copper (RCC) layers. The electrical contacts are made by laser drilling and Cu metallization. The second technology, which is mainly used for flexible substrates, uses flip chips with very thin interconnects. The chips are soldered or glued to flex substrates, followed by an embedding in an adhesive layer. Both technologies result in chips which are fully integrated in a flat substrate, either rigid or flex. In both cases further layers of inductors, resistors, and capacitors can be integrated. If desired, conventional SMT components can be assembled on top of such packages.
The realization of three applications will be described in more detail. One is a Chip Card controller IC, embedded in a 4-layer PCB structure with a total resulting thickness of only 300 µm. A second application is a thin package for a power MOSFET. In this case, a coreless construction is used, i.e. the chip is embedded into a dielectric in between two Cu layers. This construction gives a simple and cost effective package. Thickness of the vertical power IC is 200 µm. In a third application, embedding of thin chips into flexible PCBs follows two steps; firstly the flip chip with very thin solder cap interconnects (4µm-8µm) is by thermode bonding attached on the flex substrate and in a second step the chip containing layer is laminated and subsequently contacted to outer layers of the board by conventional laser through hole technique.
Finally, reliability results of the embedded chips after exposure in thermal storage, humidity storage, thermal cycling and moisture level sensitivity tests will be discussed.

ABSTRACT: MN116

A wireless sensor network for building structural health monitoring and seismic detection

P. Katsikogiannis[1], E. Zervas[1], G. Kaltsas[1]

[1]Department of Electronics, TEI of Athens, Aegaleo, GREECE, e-mail: G.Kaltsas@ee.teiath.gr

The aim of this work is to develop a wireless sensor network for both structural health monitoring of civil infrastructure and seismic event detection and recording. The network is consisted of a small number of nodes, on which high resolution ADXL accelerometers are connected. The nodes are placed within the building in pre-determined locations, in order to acquire and record data generated by seismic activity. A massive installation of such networks could monitor the seismic activity of wide areas within a city, allowing civil safeguard to act quickly in case of serious earthquakes events. The nodes are stationary and the network is self-organized and self-configured. We mainly focus on the routing protocol of the network and the time synchronization of the data. Since all data are gathered to a master node placed at the base of the building, successful transmission to that node is of great importance. Therefore, the developed routing protocol emphasize at the delivery robustness of the transmitted data, trading off latency. Data travel through a multi-hop order and no periodic routing advertisement is required. Regarding the time synchronization, the desired accuracy is on the order of 1ms. In order to achieve such accuracy, a time synchronization protocol has been developed. Clock differences and drifts between the nodes are calculated and taken into account when synchronizing the acquired data, thus accomplishing even better accuracy (tens of µs). In future work, energy efficiency will be taken into consideration in order to prolong every node's battery lifetime. Conclusively, a wireless sensor network has been developed in order to sense seismic activity. Delivery robustness and time synchronization are of great importance, therefore routing and time synchronization protocols have been created. Experimental evaluation in laboratory specially designed set-up, proved that the performance of both protocols meet the needs of the proposed application.

SESSION 5: MICRO AND NANO FABRICATION II

INVITED TALK I6

High-resolution 3D nanomanufacturing with ultrashort laser pulses

Boris N. Chichkov

Laser Zentrum Hannover e.V., Hollerithallee 8, 30419 Hannover, Germany, e-mail: b.chichkov@lzh.de

The rapid technological development of ultrashort laser systems creates a lot of exciting possibilities for laser-based micro- and nanotechnologies. One of the important examples in this field is the recent progress in high-resolution 3D nanomanufacturing by two-photon polymerization technique. By applying nonlinear multiphoton illumination, many photosensitive polymers can be structured in 3D with the resolution down to 100 nm using 800 nm laser wavelength. When tightly focused into the volume of a photosensitive material, femtosecond laser pulses interact with material through two-photon absorption. As a result a highly localised material modification can be produced. For example, one can initiate polymerization process transferring liquid into the solid state. Moving the laser focus in 3D leaves the trace of modified material. This allows the fabrication of any computer generated 3D structure by direct laser "recording" into the volume of photosensitive material. After the illumination, the unmodified material is removed by an appropriate developer, and the fabricated structure is revealed.
In this presentation, many applications of this 3D nanomanufacturing technology will be discussed.

INVITED TALK I7

More than Moore by VLSI N(M)EMS on CMOS

Peter Vettiger

IBM Zurich Research Laboratory, Rüschlikon, Switzerland
& CSEM / IMT University of Neuchatel, Switzerland

Nano/Micro-Electromechanical Systems ((N)MEMS) combine mechanical and electrical functionalities at the micro- and nanometer scale to perform new system functionalities and/or achieve better system performance. In a general sense, the electronics part in such systems actuate, sense and control the functionalities of the mechanical devices. At the beginning of the MEMS age, mechanical and electronic parts were fabricated independently, then assembled, wired and packaged for a complete system.
Well-known and successful large-volume examples of this are the great variety of different devices to sense fire, gases, liquids, pressure, humidity, explosives, shock, and acceleration in our houses, cars, etc. One or only a few sensors and/or actuators were used in such systems.
With the rapid advancement in CMOS technology and hence the availability of processing know-how, tooling and micro/nanofabrication, the foundation for VLSI-(N)MEMS (very large scale integration/interconnection) devices on CMOS became feasible and attractive.
This talk will give an overview of complex VLSI-(N)MEMS devices on CMOS platforms for applications in information/communication technology and life sciences. Among them are the digital micromirror device (DMD) as developed by Texas Instruments for applications in projection beamers and large-scale displays [1], NxN optical MEMS switches [2], IBM's highly parallel AFM data-storage system [3,4] with thousands of thermomechanical AFM probes to store data very densely at up to 1Tbit/in^2, and AFM probe arrays for imaging and force spectroscopy for life-science applications in a liquid environment [5].

References

[1] L.J. Hornbeck, "Current status of the digital micromirror device (DMD) for projection applications", Int. Elelectron Devices Technical Digest, pp. 381-384 (1993)

[2] M. Zickar, W. Noell, C. Marxer., and N.F. de Rooij. "4×4 and 8×8 optical cross connect for optical fiber networks"; MEMS, MOEMS, and Micromachining Conf. Strasbourg, France, April 2004, *Proc SPIE,* Vol. 5455: pp. 212-219.

3] P. Vettiger, G. Cross, M. Despont, U. Drechsler, U. Dürig, B. Gotsmann, W. Häberle, M.A. Lantz, H.E. Rothuizen, R. Stutz, G.K. Binnig, "The 'millipede' - nanotechnology entering data storage", *IEEE Trans. Nanotechnol.*, Vol. 1, No. 1, pp. 39-55 (2002)

[4] H. Pozidis, P. Bächtold, J. Bonan, G. Cherubini, E. Eleftheriou, M. Despont, U. Drechsler, U. Dürig, B. Gotsmann, W. Häberle, C. Hagleitner, D. Jubin, A. Knoll, M.A. Lantz, A. Pantazi, H.E. Rothuizen, A. Sebastian, R. Stutz, and D. Wiesmann, "Scanning probes entering data storage: From promise to reality", *Proc. 2006 IEEE Conf. on Emerging Technologies - Nanoelectronics, Singapore, Jan. 2006*, pp. 39-44.

[5] J. Polesel-Maris, L. Aeschimann, A. Meister, R. Ischer, E. Bernard, T. Akiyama, M. Giazzon, P. Niedermann, U. Staufer, R. Pugin, N.F. de Rooij, H. Heinzelmann, and P. Vettiger, "Piezoresistive cantilever array for life sciences applications." Proc. Int'l Conf. on Nanoscience and Technology ICN&T 2006 , Basel, Switzerland, 006, . *Phys.: Conf. Series* (May 2007, in press).

ABSTRACT: MN91

Three-dimensional photonic crystals containing a nonlinear optical chromophore

M. Farsari[1*], A. Ovsianikov[2], M. Vamvakaki[1], B.N. Chichkov[1,2], C. Fotakis[1]

[1]Institute of Electronic Structure and Laser (I.E.S.L.), Foundation for Research and Technology-Hellas (FO.R.T.H.), Vassilika Vouton, GR-711 10 Heraklion, Crete, Greece.
[2]Laser Zentrum Hannover e.V., Hollerithallee 8, D-30419 Hannover, Germany
*mfarsari@iesl.forth.gr

Photonic crystals are considered to be the optical equivalent of semiconductors as they modify the properties of light in the same way a semiconductor does for electrons[1]. It is believed that by replacing the relatively slow electrons with photons, it will eventually allow the creation of optical equivalents of diodes and transistors that will one day enable the building of an all-optical computer. However, in contrast with electrons, photons cannot be easily dynamically tuned. For this reason, it is very important to make photonic crystals made of nonlinear (NLO) materials, whose optical response will depend on the intensity of the optical field that propagates through them. The unique properties of photonic crystals made of NLO materials would allow the creation of fast and compact all-optical devices.

Despite efforts over the last decade, investigations into NLO photonic crystals have been limited to theoretical simulations and the fabrication of one or two dimensional semiconductor systems[2]. Direct laser writing by two-photon polymerization has emerged as a very promising technique for the rapid and flexible fabrication of photonic crystal templates[3]. In this work, two-photon polymerization is employed in order to make fully 3D organic NLO photonic crystals. This is achieved by incorporating a NLO- active silane into a photosensitive gel. The photonic crystal bandgap is measured and its nonlinearity demonstrated.

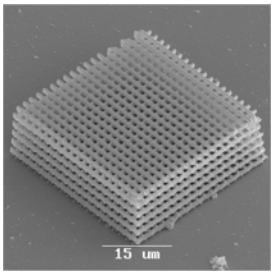


Figure 1 3D nonlinear photonic crystal made by two-photon polymerization

[1] C. M. Soukoulis, ed., Photonic Crystals and Light Localization in the 21st Century (Kluwer Academic (2001).
[2] M. Bahl,N.-C. Panoiu, R. M. Osgood Jr., Phys. Rev. E , 67, 056604 (2003).
[3] M. Deubel, G. von Freymann, M. Wegener, S. Pereira, K. Busch, and C. M. Soukoulis, Nature Mat., 3, 444, (2004).

ABSTRACT: MN127

Novel Photonic Media Based on Nanostructured Semiconductors and Dielectrics

Pavel K. Kashkarov, Leonid A Golovan', Stanislav V. Zabotnov, Dmitri A. Mamichev and Victor Yu. Timoshenko

Moscow State M. V. Lomonosov University, Physics Department, 119992 Moscow, Russia

Nanostructuring of semiconductors and dielectrics is a promising way for fabricating novel photonic and nonlinear optical media. Electrochemically prepared porous silicon (PS), oxidized PS (OPS), and porous alumina (PA) consist of nanostructures and voids with dimensions varied from 1-2 to 200-300 nm. 1D and 2D photonic crystals as well as birefringent media can be easily formed on the base of PS, OPS, and PA by choosing size, shape and spatial orientation of nanostructures.

Multilayer structures of PS show 1D photonic band gap (PBG) tunable with the period of structure, sizes of Si nanocrystals and their dielectric surroundings. Experiments demonstrate possibility to reach quasi-phase matching for second-harmonic (SH) generation in PS multilayers. PS layers produced by anisotropic electrochemical etching of (110)-oriented c-Si wafers exhibit strong in-plane birefringence. PA films possess properties of a positive uniaxial crystal having the optical axis along the pores. The birefringence of PS, OPS, and PA is tunable by changing the porosity and/or dielectric properties of material embedded in pores. The obtained multilayered structures on the basis of birefringent PS exhibit large differences (50-100 nm) in PBG positions for different light polarization. This property can be used in fabricating photonic components like dichroic mirrors, filters, "planar Brewster" windows, etc. Our experiments on the SH and third harmonic (TH) generation have revealed phase matching conditions for wave interactions in in-plane birefringent PS and OPS layers. A strong enhancement of the SH and TH radiation intensities was observed under the phase matching conditions in anisotropic photonic media.

Thus, electrochemically nanostructured semiconductors and dielectrics are promising photonic materials. The strong in-plain birefringence of anisotropically nanostructured materials allows us to control the efficiency of SH and TH generations. Furthermore, the PBG and/or birefringent PS can serve as phase-matching matrices for optically nonlinear substances incorporated in their pores, expanding significantly the choice of nonlinear optical materials.

This work has been supported by RFBR and INTAS, and by grants of the Ministry of Education and Science of the Russian Federation.

ABSTRACT: MN113

Random Laser Action in ZnO Nanohybrids

A. Stassinopoulos[1,2], E. D. Tsagarakis[3], R.N. Das[3], S.H. Anastasiadis[1,4], E.P. Giannelis[3], D. G. Papazoglou[5], D. Anglos[1]

1. Instit. Electronic Structure & Laser, Foundat. for Research & Technol.-Hellas, P.O. Box 1385, 71110, Crete, Greece, 2. Depart. Physics, Univ. of Crete, 71103, Greece, 3. Depart. Mat. Sci. & Engin., Cornell Univ., Ithaca, NY 14853, USA, 4. Depart. Chem. Engineer., Aristotle Univ. of Thessaloniki, 54124, Greece, 5. Materials Science & Technology Depart., Univ. of Crete, 71103, Greece

Highly scattering hybrid structures are produced either by incorporating zinc oxide nanoparticles in a variety of inert organic polymeric or inorganic sol-gel matrices or by depositing nanoparticles on flexible substrates. All structures exhibit intense laser-like emission upon optical pumping. The ZnO particles provide both the gain and the strong scattering power, which leads to photon localization due to multiple elastic light scattering. The polymer matrix offers ease of material fabrication and processability while the elastic substrate offers flexibility in view of potential applications. Excitation of the nanohybrids by laser pulses shows threshold behavior demonstrated by a dramatic increase in the emitted light intensity and a significant spectral (Fig. 1a) and temporal (Fig. 1b) narrowing.[1]

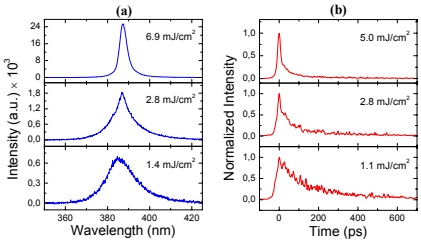


Fig. 1 (a)Spectrally- and (b) Time- resolved photoluminescence emission from ZnO nanocomposites for pumping energy densities below, around and above the random lasing threshold.

A series of studies that investigate the influence of pump pulse duration and sample temperature on the random laser efficiency are presented along with coherence length measurements[2] on selected samples. Nanocomposite fabrication issues and pumping conditions are discussed in the context of performance optimization and potential use of such materials in future light emission devices.

References

1. D. Anglos, A. Stassinopoulos, R. N. Das, G. Zacharakis, M. Psyllaki, R. Jakubiak, R. A. Vaia, E. P. Giannelis, and S. H. Anastasiadis, "Random laser action in organic–inorganic nanocomposites," J. Opt. Soc. Am. B 21, 208-213 (2004).
2. V. M. Papadakis, A. Stassinopoulos, D. Anglos, S. H. Anastasiadis, E. P. Giannelis, D. G. Papazoglou, "Single-shot temporal coherence measurements of random lasing media" J. Opt. Soc. Am. B 24, 31-36 (2007)

ABSTRACT: MN78

Fabrication of micron-scale GaN-based devices via AlInN selective oxidation and etching

A. Castiglia, D. Simeonov, H. J. Buehlmann, J. Dorsaz, A. Altoukhov, J.-F. Carlin, E. Feltin, R. Butté, and N. Grandjean

Ecole Polytechn. Fédérale de Lausanne (EPFL), Instit. of Quantum Electronics & Photonics, CH-1015, Switzerland, antonino.castiglia@epfl.ch

III-nitride alloys find successful applications in semiconductor optoelectronics. Commercially available UV-blue laser diodes (LDs) and high efficiency light emitting diodes (LEDs) are two of the most representative examples among (Al, In, Ga)N based devices. However, the lack of well established selective oxidation and etching processes has prevented, or at least limited, the development and fabrication of specific structures such as current confinement structures for electrically pumped vertical cavity surface emitting lasers (VCSELs), microdisks (µdisks), single photon emitters or micro-electro-mechanical systems (MEMS).

Here we report on the fabrication InGaN/GaN micron-scale light emitting diodes (µLEDs) and of blue µdisk lasers through the selective lateral oxidation and etching of AlInN interlayers, lattice matched to GaN.

Based on the abovementioned oxidation process, blue InGaN/GaN LEDs with micron-scaled apertures (µLEDs), have been realized. Lateral selective anodic oxidation of an AlInN interlayer, inserted in the LED structure, is used to define current apertures with diameters below 3 µm (Fig. 1). The current confinement into the apertures is demonstrated by fine microelectroluminescence and microphotoluminescence (µPL) characterization. Devices are safely driven, in continuous mode operation, up to current densities as high as 20 kA/cm^2, a value theoretically suitable for an electrically pumped VCSEL, with maximum external quantum efficiencies of 2.5%.

The fabrication of blue µdisks involves an additional processing step consisting in the wet etching of the oxidized interlayer. Through this two step process high quality mushroom-shaped µdisks have been fabricated (Fig. 2 (a)). Under continuous wave excitation, whispering-gallery modes with quality factors up to several thousands (> 4000) are observed (Fig. 2 (b)). Lasing is achieved under pulsed excitation for the high energy modes (Fig. 2 (c); threshold ≈ 400 kW/cm^2). The obtained results highlight the relevance of the AlInN oxidation technique in the III-

nitride processing flow, which could also be used for the fabrication of brand new devices like GaN-based MEMS or single photon emitters.

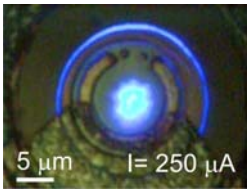


Fig.1: µLED under a current bias of 250 µA.

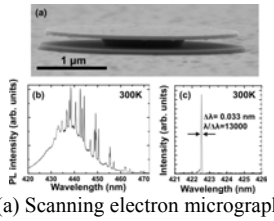


Fig 2: (a) Scanning electron micrograph of a µdisk; µPL spectrum of a µdisk (b) below and (c) above threshold.

SESSION 6: NANOSTRUCTURES AND APPLICATIONS

INVITED TALK I8

The Electrical Transport Mechanisms in Ensembles of Silicon Quantum Dots

Isaac Balberg

The Racah Institute of Physics, The Hebrew University, Jerusalem 91904, Israel

The electrical and optical properties of single semiconductor quantum dots became quite well understood in recent years. In contrast, the corresponding understanding of ensembles of such dots is still at a very rudimentary level, which is manifested by the diversity of the mechanisms that were suggested to account for these properties. Following that we have carried out a systematic study of the structure [1], the optical [2] and the transport and charge storage [3] phenomena in ensembles of silicon quantum dots as a function of their density. We have found a striking matching between the density dependence of the photoluminescence and charge storage as well as a mutual exclusion of these and the large Ohmic conductivity that is found above the percolation threshold in such systems. These results yield a comprehensive picture of the transport as composed of migration of carriers within the clusters of the quantum dots and sequential tunneling between the clusters. The corresponding transport mechanisms appear to explain, in a systematic way, many of the conflicting results reported in the literature as being due to particular densities of the silicon quantum dots.

1] M. Dovrat, Y. Goshen, I. Popov, J. Jedrzejewski, I Balberg and A. Sa'ar, Phys. Stat. Sol. (C) 2, 3440 (2005)
2] M. Dovrat, Y. Oppenheim, J. Jedrzejewski, I. Balberg and A. Sa'ar, Phys. Rev. B, 69, 155311 (2004)
3] I. Balberg, E. Savir, J. Jedrzejewski, A.G. Nassiopoulou, S Gardelis, Phys. Rev. B, 75, 225329 (2007).

ABSTRACT: MN24

Micro and nano – scale silicon : potential applications in toothpaste

Leigh Canham

pSiNutria Ltd, Malvern Hills Science Park, Geraldine Rd, Malvern, Worcestershire, WR14 3SZ, UK

Toothpaste is currently a $14 billion dollar market worldwide and yet huge numbers of its consumers are unaware that they clean their teeth with ground glass. Low porosity silica microparticles are the abrasive material used in most commercial toothpaste formulations. A wide range of materials have been tested but few possess the necessary combination of mechanical, chemical and optical properties, toxicology, and low cost. Silicon is a mechanically stronger and softer material than silica and the abrasive performance of silicon microparticles is unexplored. We have studied the stability of nanoscale silicon in toothpaste and human saliva, and their capability to be retained in human tooth cavities following brushing (1). More targeted delivery of anti-caries agents to teeth remains an important objective for toothpaste manufacturers. Extended release of a flavouring agent (peppermint oil) has also been investigated in-vitro.

(1) PCT Application WO 2006/111761. Oral Hygiene Compositions

ABSTRACT: MN132

Silicon nanocrystals as efficient photosensitizers of erbium ions for optoelectronic applications

V. Yu. Timoshenko[1], O.A. Shalygina[1], D.M. Zhigunov[1], S.A. Dyakov[1], N.I. Komarevsky[1], P. K. Kashkarov[1], M. Zacharias[2], M. Fujii[3], and Sh. Hayashi[3]

[1]Moscow State M.V.Lomonosov University, Physics Department, 119992 Moscow, Russia, e-mail: timoshen@phys.msu.ru, [2]Max-Planck-Institut für Mikrostrukturphysik, Weinberg 2, 06120 Halle, Germany, [3]Kobe University, Faculty of Engineering, Department of EEE, 657-8501 Kobe, Japan

Er-doped materials based on silicon have attracted a great deal of attention because Er^{3+} ions in a solid matrix can emit a sharp luminescence line at 1.5 μm, which matches the silica fiber-based optical communication systems compatible with planar Si-technology. This fact determines possible applications of Er-doped Si-based material in light-emitting optoelectronic devices. We analyze the photoluminescence properties of undoped and Er-doped structures of Si nanocrystals in silicon dioxide matrix (nc-Si/SiO_2 structures) at different temperatures and excitation intensities. Undoped nc-Si/SiO_2 structures are found to exhibit the photoluminescence band with the spectral position tuneable from 1.3 to 1.7 eV for the mean nanocrystal size varied from 4.5 to 1.5 nm. The Er-doped structures are characterized by the photoluminescence at 0.81 eV, which results from the radiative de-excitation of the Er ions excited by the energy transfer from Si nanocrystals. It is found that (i) the Er luminescence yield and lifetime are dependent on the nanocrystal size, temperature, and excitation intensity, (ii) the rate of the energy transfer from the nanocrystals to the ions can exceed the nonradiative recombination rate in the samples; (iii) the population inversion of the Er ion energy states is achievable under strong optical pumping. The experimental results agree with numerical simulations based on the rate equations for a coupled system of Si nanocrystals and Er ions. The luminescence properties of Er-doped nc-Si/SiO_2 structures are discussed in view of possible applications in optical amplifiers and lasers compatible with Si-based technology.

ABSTRACT: MN48

Determination of critical points of nanocrystalline silicon films: the role of grain boundaries in the optical properties

Emmanouil Lioudakis[1,*], Andreas Othonos[1] and A. G. Nassiopoulou[2]

[1] Research Center of Ultrafast Science, Department of Physics, University of Cyprus, P.O. Box 20537, 1678, Nicosia, Cyprus
[2] IMEL/NCSR Demokritos, P.O. Box 60228, 15310, Aghia Paraskevi, Athens, Greece
*mlioud@ucy.ac.cy

The enormous growth in both the academic pursuit and industrial application of nanocrystallites stems from the remarkable variations in the electrical and optical properties that occur as an infinitely extended solid is miniaturized to a piece of material consisting of a countable number of atoms. In this work, we present a comprehensive study of the optical properties of nanocrystalline silicon films with thickness varied from 5 to 30 nm. Spectroscopic ellipsometry is employed to determine the dielectric functions of these films using a structural two-layer model based on the rigorous Airy formula. Our investigation gives an important insight of the origin of critical points for direct and indirect gaps of nanocrystalline silicon films as well as the evolution of them with decreasing the film thickness. The influence of the quantum confinement effect due to the nanoscale grain size and the surface vibrations at the interface on the optical properties are examined in detail. The coupling between surface vibrations and quantized sublevels as well as the increase of interaction between them at the strong confinement regime are proposed for the observable pinning of fundamental gap.

ABSTRACT: MN161

New effects in finite-length silicon nanowires

A. D. Zdetsis, E. N. Koukaras , C. S. Garoufalis

Department of Physics University of Patras, Patra , GR2500 Greece

By considering silicon nanowires in real space, we have shown by *ab initio* theoretical calculations that unstable nanowires bend under relaxation. These nanowires usually incorporate in their surface silicon dihydrides parallel to the nanowires axis. On the other hand, nanowires without such parallel dihydrides remain straight and are characterized by increased stability or "magicity". Reconstructed nanowires have analogous properties but they are characterized by much higher stability. This bending of the nanowires cannot be accounted for by the usual k-space models which use a one-dimensional periodic arrangement of the simulation cell. Our theoretical models are based on STM images and schematic views from the experimental results of Ma et al. [Science, 229, 1874,(2003)]. Our results are in full accord with these experimental data and interpretations.

SESSION 7: DEVICES

ABSTRACT: MN59

Influence of current injection on the electroluminescence properties of GaN-based LEDs

Carmen Salcianu[1, 2], Ted Thrush[1], Clifford McAleese[1] and Colin Humphreys[1]

[1]Department of Materials Science & Metallurgy, Univ. of Cambridge, CB2 3QZ, UK
[2]Thomas Swan Scientific Equipment Ltd., Cambridge, CB4 5FQ, UK

Environmentally friendly and low-energy consumption light sources have big potential applications in traffic lights, full-color displays, and solid-state lighting [1]. An important factor that hinders the uptake of LEDs into the general lighting market is their price and there remains many aspects of fabrication that need to be explored and improved.

Non-destructive characterization of LED structures prior to the fabrication of chips can play an important role in reducing the overall cost by limiting effort-intensive device processing to material of proven quality. Photoluminescence (PL) is primarily used to assess the optical properties of the LED structures, but these measurements only provide a rough guide to how the active layer will perform optically when driven by current injection and moreover they do not account for the electrical properties of the whole structure. A more appropriate method to assess material intended for use in LEDs is to electrically inject electrons and holes into these structures and to compare the resulting electroluminescence (EL) spectra and I/V characteristics of the wafers under test.

This paper will present wafer scale optoelectronic data, obtained using point-contact current injection and planar current injection on as-grown LED structures. Although such measurements have provided a useful insight into the current injection mechanisms and therefore on the epiwafer quality, developments are still needed in the methodology of the characterisation technique if a reliable assay of the wafer's device potential is to be realised. Improvement of the method has resulted from changes in the LED structure by insertion of a p^+-p junction contact and also the insertion of a p-AlGaN/GaN superlattice. The improved conductivity due to an enhanced average hole concentration [2] also results in an increased EL intensity shown by electroluminescence measurements undertaken both at the wafer scale and on the LED chips.

References:

[1] P. Waltereit et al./ APL. 84 (2004) 2748
[2] P. Kozodoy et al./APL 75 (1999) 2444

ABSTRACT: MN98

Metallic Contacts Effect Estimation on (SI) GaAs Soft X-Ray Radiation Detectors Performance

V G Theonas[1*], G Konstantinidis[2] & G J Papaioannou[1]

[1] Solid State Physics Section, Physics Dept., N.K.U.A, Panepistimiopolis Zografos, 15784 Athens, Greece
[2] Instit. of Electr. Struct. & Laser, Found. for Research & Technol., Vassilika Vouton, 71110 Heraklion, Crete, Greece
*vtheonas@phys.uoa.gr

Radiation detectors are implemented in medical, environmental, industrial, geological and other applications. Especially X-ray detectors gave the ability to produce, high resolution digital radiography systems. (SI) GaAs is one of the most promising compounds used in this technology area. The detector efficiency is affected by several parameters. In order to achieve the acceptable detection results, the device must be fabricated by high purity material containing the minimum possible concentration of deep donors or by highly compensated material. The detector's width must be low enough in order to achieve a wide active region but not very low for attaining the desirable photon absorption. Electrical contacts of the detector are of great importance. Contacts must allow the detector to be biased by voltage high enough, to produce an efficient reverse bias current pulse. Pulse formation is mainly affected by the number of charge carriers induced by photons within the detector's active region, charge distribution within the semiconductor volume and charge kinetics.

In the present work we conducted theoretical calculations of the electrical contacts effect on the induced charge formation and distribution and the transient response of SI GaAs detectors, irradiated by soft X-ray photons. The simulated detector is a typical reverse biased Schottky diode of high purity undopped GaAs or compensated material. Metallic contacts are assumed to be fabricated by 100% Au (Schottky) and 88% - 12% Au – Ge alloy (Ohmic). The aim of our work is to estimate the effect of metallic contacts composition and thickness to the detector's performance.

Simulation results indicate that there is an essential electron injection from the vicinal metallic contact layers towards GaAs substrate that affects the induced charge amount and distribution and finally the detector's performance. Charge induced within the semiconductor volume, is ruled by the choice of the irradiated contact and it's composition and thickness.

ABSTRACT: MN171

Photochemical study of red fluorescent emitters for application in Organic Light Emitting Diodes (OLEDs)

D. Georgiadou[1,3], M. Vasilopoulou[1], G. Pistolis[2], D. Dimotikalli[3] and P. Argitis[1*]

[1]Inst. of Microelectronics, NCSR "Demokritos", 15310 Athens, Greece
[2]Inst. of Physical Chemistry, NCSR "Demokritos", 15310 Athens, Greece
[3]Department of Chemical Engineering, National Technical University of Athens, 15780 Athens, Greece
*argitis@imel.demokritos.gr

Organic Light Emitting Diodes (OLEDs) are already playing an increasingly competitive role in the display market and in lighting applications. The development of high performance materials is of utmost importance for the overall performance of the device. Among others, the development of red light emitters with high luminous efficacy, colour purity and appropriate photochemical properties remains one of the of the hot research topics.

In the present study two different fluorescent red emitters were tested: the well known and widely used (4-(dicyanomethylene)-2-methyl-6-(4-dimethylamino-styryl)-4H-pyran) (DCM) and the recently introduced (4-dimethylamino-4'-nitrostilbene) (DANS). Each emitter was dispersed inside a conductive polymer matrix, Poly(9-vinylcarbazole), (PVK), at various concentrations along with an appropriate amount of photoacid generator (PAG). The successful energy transfer from the blue emitting conductive polymer to the red emitters was studied through absorption and photoluminescence spectroscopy. The photochemically induced spectral changes of the two red fluorescent emitters, due to protonation of the amino groups by the photogenerated acid, were also studied and compared. The DANS absorption spectrum shift is much more pronounced compared to the one of DCM whereas in both cases protonation results to fluorescence bleaching.

Finally, organic light emitting devices were fabricated having the structure ITO/PEDOT:PSS (40 nm)/PVK with the red emitter and PAG (80 nm)/Al (300 nm). The PVK layer was prepared by spin coating using a solution containing the polymer along with the appropriate amounts of the emitter and the PAG. The role of the PEDOT:PSS film was to improve the hole injection and substrate smoothness. Current density-Voltage (J-V) curves and electroluminescence spectra of the OLEDs were recorded and the CIE colour indexes were defined. Further research on red as well as green emitters is in progress.

ABSTRACT: MN64

Deposition and electrical characterization of hafnium oxide films on silicon

E. Verrelli[1], D. Tsoukalas[2], D. Kouvatsos[3]

[1] Nat. Techn. Univ. of Athens, Heroon Polytechniou Str. 9, Zographou Campus GR-15773, Athens, Greece, verrelli@central.ntua.gr, [2]Nat. Techn.Univ. of Athens, Heroon Polytechniou Str. 9, Zographou Campus GR-15773, Athens, Greece, dtsouk@central.ntua.gr, [3] Institute of Microelectronics, NCSR "Demokritos", 15310 Aghia Paraskevi, Greece, D.Kouvatsos@imel.demokritos.gr

Hafnium oxide dielectric is under intense investigation in recent years as a new high-k insulator to replace silicon dioxide thus allowing further device scaling in silicon technology. In this work we investigate HfO2 deposited films using RF reactive sputtering technique and we present results on their electrical characterization using MOS capacitors. The emphasis of our investigation is on low temperature deposited films from room temperature and up to 300 ˚C.

We have used n-type silicon wafers that have been cleaned prior to deposition using HF-last cleaning process to minimize interfacial silicon dioxide thickness. The HfO2 films have been sputtered from high purity HfO2 target at low deposition rate (0.3 Å/s) monitored by a quartz crystal. The wafer temperature has been controlled by a heater. After deposition of the insulator aluminum has been evaporated and patterned to form MIS capacitors.

Electrical characterization involves C-V and I-V measurements that allow us to investigate both interfacial and bulk electrical properties of the insulator. Along these lines we have measured interface state densities of HfO2 with silicon as a function of deposition temperature and also as a function of post metallization annealing conditions. It appears that although interface electrical quality increases with deposition temperature electrical conductivity of the films exhibits good insulating properties even for room temperature deposited films. Post metallization annealing in the range 300 – 500 ˚C results in further lowering of interface state density and film quality increase.

The work demonstrates that low temperature deposited and processed HfO2 films could be an interesting solution for low thermal budget requirement technologies as for example TFTs as well as for control oxide of metallic nanocrystal memories [1].

[1] E.Verrelli *et al*. Microelectronic Engineering 84 (2007) 1994–1997

ABSTRACT: MN13

Physics Based Capacitance Modeling of Short-Channel Double Gate MOSFETs

Håkon Børli, Kristian Vinkenes and Tor A. Fjeldly

UniK – Univ. Graduate Center, Norwegian Univ. of Sci. and Technol., Instituttveien 25, 2027 Kjeller, Norway.

We present a 2D physically based compact model of the Double Gate MOSFET, with emphasis on short-channel devices of nanoscale dimensions. A framework model of the drift diffusion current modeling has been presented for the DG device [1-3]. In order to obtain a complete large signal model of the device, capacitances in all operation regions, from sub threshold to strong inversion, are now included.

The four terminal DG MOSFET can be described with 16 trans-capacitances, of which 9 are independent due to charge conservation principle according to the Ward-Dutton model. If we assume symmetrical gate biasing, the DG can be considered a 3 terminal device, and the number of trans-capacitances to can be reduced to 9, of which 4 are independent.In the sub-threshold regime of a lightly doped DG MOSFET, the electrostatics is dominated by the capacitive coupling between the electrodes. In this regime of operation, the electrostatics of the device can be approximated by the Laplace equation, which can be analytically solved using conformal mapping techniques [1]. From this analytical solution, we can calculate the perpendicular electric field along the gate, source and drain electrodes. The electrode charge is found by integrating the perpendicular electrical field along the desired electrode, and finally the trans-capacitances are obtained from the derivative of the charges with respect to the electrode potentials for all combinations of electrodes and applied potentials at the four terminals. The effect of the oxide gap between the gate and the source/drain electrodes is considered specifically.Near and above threshold the influence of the electronic charge on the electrostatics has been taken into account in a precise, self-consistent manner by combining suitable model expressions with the 2D Poisson's equation in the device body [2].

Since short-channel effects are inherently contained in this analysis, no adjustable parameters are needed. The modeling framework covers the full range of bias voltages from sub-threshold to strong inversion. The device considered has a gate length of 25 nm and a silicon thickness of 12 nm, permitting the use of classical electron statistics. The device electrostatics and the capacitances calculated from the present models are compared with numerical simulations.

References

[1] S. Kolberg, T. A. Fjeldly, B. Iñiguez, "Self-Consistent 2D Compact Model for Nanoscale Double Gate MOSFETs ", *Lecture Notes in Comp. Science,* Springer, Berlin, Vol. 3994, pp. 607-614, 2006 .

[2] H. Børli, S. Kolberg, and T. A. Fjeldly, "Compact Modeling Framework for Short-Channel DG and GAA MOSFETs " (invited paper), NSTI Nanotech 2007, Workshop on Compact Modeling, Santa Clara, CA, May 20-24, 2007, 2007, vol.3, pp. 505-509.

[3] S. Kolberg, H. Børli, and T. A. Fjeldly, "Modeling, Verification and Comparison of Short-Channel Double Gate and Gate-All-Around MOSFETs", accepted, *J. Math. and Comp. in Simulations*.

ABSTRACT: MN187

Numerical simulation of quantum transport in DGMOS using Coupled Poisson-deterministic Wigner-Schrödinger equations

J. Kefi-Ferhane & A. Poncet

INL, Institut des Nanotechnologies de Lyon, INSA de Lyon, Bât, Blaise Pascal. 7, av. Jean Capelle. F 69 621 Villeurbanne CEDEX, e-mail: jihene.kefi@insa-lyon.fr, alain.poncet@insa-lyon.fr.

With the continuous down-scaling of nanoelectronic devices such as thin film Double Gate MOSFETs, it becomes necessary to account for both quantum confinement and quantum transport including scattering effects which occur in the structure. One way to simulate these phenomena at low CPU cost is to solve a coupled system with 1D-Schrödinger equation to describe transverse quantum confinement, 1D-Wigner equation for longitudinal quantum transport and 2D-Poisson equation to simulate the full electrostatic behavior.

In this communication, the numerical implementation of the Wigner equation is based on a deterministic approach as suggested by F.~A. Buot and K.~L.~Jensen. In order to guarantee the consistency of the system, we have set up an iterative loop which works as follows in a thin-film double gate MOSFET : Starting from an initial guess, non-linear Poisson equation is solved over the full 2D device, next Wigner distributions are computed along each mesh line, and finally 1D-Schrödinger equations are solved along each mesh slice, with an automatic fit of the Fermi level to achieve the same charge density at a given position along the channel as those deduced from Wigner distributions.

A key issue in the simulation of short channel MOSFETS as well as RTDs is the proper dimensioning of the reservoirs. This point will be addressed carefully. Scattering mechanisms have been introduced in Wigner equation by means of a Boltzmann-like collision operator in the relaxation-time approximation. Scattering can be described at several levels: at the lowest level, analytical expressions of relaxation times can be taken from the literature. But in order to fully exploit the knowledge of wave functions brought by Schrödinger equations, we have used form factors to account for phonon scattering by means of classical Matthiessen rule. The full paper will highlight how they explain the dramatic mobility reduction in ultra thin silicon films.

SESSION 8: FABRICATION AND CHARACTERIZATION OF NANOSTRUCTURES

ABSTRACT: MN66

Strain relaxation in AlN/GaN heterostructures grown by molecular beam epitaxy

G.P. Dimitrakopulos[1,*], Ph. Komninou[1], Th. Kehagias[1], S.-L. Sahonta[1], J. Kioseoglou[1], I. Hausler[2], W. Neumann[2], E. Iliopoulos[3], A. Georgakilas[3], and Th. Karakostas[1]

[1]Solid State Section, Physics Department, Aristotle University of Thessaloniki, GR 54124, Greece, [2]Institute of Physics, Humboldt Univ. Berlin, Newtonstreet 15, 12489 Berlin, Germany, [3]Microelectronics Research Group, Depart. of Physics, Univ. of Crete, P.O. Box 2208, 71003 Heraklion, Greece; and IESL, FORTH, P.O. Box 1527, GR 71110 Heraklion-Crete, Greece, *email: gdim@auth.gr

AlN-GaN alloys have important potential for a variety of device applications such as high electron mobility transistors, short-wavelength light-emitting devices and highly reflective epitaxial distributed Bragg reflectors. In addition, AlN interlayers can be employed in order to induce bending of threading dislocations due to the lattice mismatch, as well as to relieve tensile strain between GaN and AlGaN. However, the strain is the source of defects with increasing Al concentration or layer thickness. In addition to increased densities of threading and misfit dislocations, it also leads to cracking especially when the number of epitaxial layers increases. Strain control is also important for optimization of the electrical properties of the AlGaN/GaN heterojunction influenced by internal polarization.

In the present work we report on an AlN/GaN multilayer heterostructure that was grown by radio-frequency plasma-assisted molecular beam epitaxy (rfPAMBE) under group-III rich conditions, and comprised seven AlN layers of increasing thicknesses, from 3 nm up to 100 nm, with 150 nm GaN spacers. The critical thicknesses, strain relaxation mechanisms and interfacial structures were studied using a combination of transmission electron microscopy (TEM) techniques, in particular high-resolution TEM (HRTEM), high-angle annular dark-field (HAADF), and geometrical phase analysis. Gradual relaxation of the layers and introduction of interfacial roughness is observed. Threading dislocations with **a**-type Burgers vectors and misfit dislocation arrays were found to be introduced mainly above 6 nm AlN thickness, as well as cracks and V-defects. The threading dislocations are interconnected to the misfit ones and may re-enter the interfaces or form semi-loops. Glide of threading dislocations to form misfit dislocations was also detected. Threading dislocations were observed to adopt inclined zig-zag line directions and contribute to the relief of alternating compressive-tensile elastic strain across the heterostructure. Strain partitioning occured between AlN and GaN layers of comparable thicknesses.

Acknowledgement: Work supported by the EU under the Marie Curie RTN contract MRTN-CT-2004-005583 (PARSEM).

ABSTRACT: MN50

TEM INVESTIGATIONS OF (In,Ga)N QWs by TEM

P. Manolaki[1], I. Häusler[1], H. Kirmse[1], W. Neumann[1], J. Smałc[2,3], & J. Kozubowski [3]

[1]Humboldt-Universität zu Berlin, Institut für Physik, AG Kristallographie, Newtonstraße 15, D-12489 Berlin, Germany, e-mail: panmanol@physik.hu-berlin.de
[2]Institute of High Pressure Physics, Polish Academy of Sciences, Sokolowska 29/37, 01-142 Warsaw, Poland
[3]Warsaw University of Technology, Department of Materials Science, ul. Wołoska 141, 02-507 Warsaw, Poland

Nanostructures of the III- N compound semiconductors have emerged as very promising materials due to their great potential in the production of modern optoelectronic devices such as blue and ultraviolet LEDs and laser diodes. The aim of this work is to report on the influence of the growth temperature to the structural and chemical properties of (In,Ga)N quantum wells (QWs) by TEM.
Two different samples A and B were fabricated. The (In,Ga)N/GaN layers were grown with metal organic chemical vapor deposition. The QWs of the sample A were grown at a constant temperature of 600 °C. For the QWs of the sample B the temperature was lowered to 530 °C, while for the GaN barrier it was set to 600 °C.
The samples were prepared for TEM by mechanical preparation comprising face-to-face gluing, formatting, mechanical polishing, dimpling, and final ion milling. Structural analysis was performed on a TEM/STEM JEOL JEM2200FS operating at 200 kV.
The structural properties were studied by diffraction contrast imaging using the 0002 reflection. Sample A exhibits homogeneous (In,Ga)N QWs. For sample B some undulated strain contrast of the QWs was visible hinting to the formation of quantum dots (QDs).
The presence of QDs in sample B was clearly evidenced by composition sensitive STEM- HAADF imaging, where the individual (In,Ga)N layers exhibit inhomogeneous intensity as well as varied thickness. No vertical correlation of the QDs was observed. Consequently, the vertical extension of the strain field of the QDs is less than the thickness of the GaN barrier of 7nm.
The generation of (In,Ga)N QDs found for the varied temperature regime can be understood as a thermally activated transformation from 2-d (QW) to 3-d (QD) caused by the rise of temperature from 530 °C to 600 °C.

ABSTRACT: MN148

TEM characterization of VLS-grown ZnTe nanowires

H. Kirmse[1], W. Neumann[1], S. Kret[2], P. Dłużewski[2], E. Janik[2], G. Karczewski[2] and T. Wojtowicz[2]

[1]Humboldt-Universität zu Berlin, Institut für Physik, AG Kristallographie, Newtonstraße 15, D-12489 Berlin, Germany
[2]Polish Academy of Science, Institute of Physics, Al. Lotników 32/46, 02-668 Warsaw, Poland

Semiconductor nanowires are one-dimensional objects having a diameter of a few tenth of nanometres and a lengths of a few micrometres. This geometry is of advantage for unique applications in the field of mesoscopic physics and for fabrication of nanoscale devices. Nanowires can be grown via a vapour-liquid-solid (VLS) mechanism where liquid metal droplets act as a catalyst. The size of the droplet determines the diameter of the nanowire, whereas its length is controlled by the duration of the growth experiment.
The ZnTe nanowires under investigation were deposited on (001) GaAs by molecular beam epitaxy, where gold was used as metallic catalyst. For TEM inspection the ⟨111⟩-oriented nanowires were harvested and transferred to a hollow carbon film. Transmission electron microscopy (TEM) characterization of both the structural and the chemical properties of the nanowires was performed at a JEOL 2200FS.
Diffraction contrast TEM imaging reveals the nanowires to be single crystals. Nevertheless numerous stacking faults (SF) are observed where the SF plane is the {111} perpendicular to the growth direction.
The ZnTe nanowires are covered by a nano-crystalline surface layer as found by high-resolution TEM imaging. The distances of the different sets of lattice planes of the nano-crystallites correspond to those of ZnO. Electron energy loss spectroscopy was applied to proof the presence of oxygen within the surface layer. The corresponding signal was found to be higher at the edge of the wire. Simultaneously, an enrichment of zinc is found evidencing to the formation of ZnO.
For a deeper understanding of the VLS mechanism the solidified gold droplet was inspected by energy dispersive X-ray spectroscopy. In addition to gold (75 at.%) mainly gallium (22 at.%) was detected within the droplet. This hints to a vivid transition of gallium into the droplet during its formation directly at the GaAs substrate surface.

ABSTRACT: MN123

On advantages and limitations of Raman spectrometry for control of nanotube inclusions in polymer composites

Eleni Spanou, George Vessiaris, Dr Andreas Kuprianou, Prof. Doumanidis Charalampos, Vladislav Ryzhkov

Rosseter Holdings PCL, Limassol, Cyprus

Being typically shorter than 0.5 µm, naturally short carbon Multi Wall Nanotubes (sh-MWNTs) are considered as non-toxic and easily dispersed in most solvents and powder matrices, enhancing production of improved composite materials. Raman spectrometry is considered as a robust and reliable technique capable to control nanotube inclusions in the composites. The paper studies advantages and limitations of Raman spectrometry for control of nanotube inclusions in different polymer matrices. Polypropylene composites were prepared by direct mixing raw nanotube powders (2.5-10wt%) with industrial grade polypropylene powders followed by further extrusion. Teflon and polystyrene foils were prepared by mixing specially pre-treated sh-MWNTs (1-10wt%) with organic solutions of the starting materials, followed by further deposition and drying. "Thick" and "thin"-layer techniques were investigated with portable Raman spectrometer (Ocean Optics) exploiting excitation wave length of 785nm and spot diameter size of ~ 100µ, providing resolution of ~ 10cm^{-1} within the Raman shift range of 200-4000cm^{-1}. A distinctive so-called "order" peak of carbon at ~ 1580cm^{-1} was used as an analytical signal. TEM, SEM, TGA, and XRD data are also discussed in the paper.

ABSTRACT: MN99

Nonlinear optical properties of Au nanoclusters encapsulated into hybrid block copolymer micelles

Kostas Iliopoulos[1,2], Dimitris Athanasiou[1], Stelios Couris[1,2],
Anastasia Meristoudi[3,4], Nikos Vainos[3,4], Stergios Pispas[3]

[1]Institute of Chemical Engineering and High Temperature Chemical Processes (ICEHT), Foundation for Research and Technology-Hellas (FORTH), P.O. Box 1414, GR-26504 Patras, Greece, e-mail: couris@iceht.forth.gr
[2]Department of Physics, University of Patras, GR-26500 Patras, Greece
[3]Theoretical and Physical Chemistry Institute, National Hellenic Research Foundation, GR-11635 Athens, Greece, e-mail: pispas@eie.gr
[4]Department of Materials Science, University of Patras, GR-26500 Patras, Greece, vainos@upatras.gr

During the last years, the study of noble metals' nanoparticles has gained considerable attention since nanoparticles with sizes smaller than c.a. 100 nm exhibit very attractive electrical and nonlinear optical properties being therefore promising candidates for a plethora of applications in optoelectronics and photonics. However, nanoparticles tend to aggregate resulting in degradation of their nonlinear optical response. Amphiphilic block copolymers in selective solvent can form well-defined micelles with the insoluble block as the core and the soluble block as the shell or corona preventing nanoparticles from undesirable aggregation and allowing for the control of the dimensions and the morphology of the encapsulating metal nanoclusters. As a result, the use of block copolymer micelles is considered to be an efficient methodology for the preparation of novel hybrid materials made up of polymers and inorganics with custom made properties.
In the present work the nonlinear optical properties of nanometer size Au clusters encapsulated in Poly(isoprene-b-acrylic acid) (PI-PAA) block copolymer micelles corresponding to different polymer/Au ratios and different nanoparticles' concentrations in THF are studied employing 35 ps and 5 ns laser excitation, by means of Optical Kerr Effect and Z-scan techniques. Both the real and imaginary parts of the third-order susceptibility $\chi^{(3)}$, related to the nonlinear refraction and absorption respectively of these hybrid materials, have been determined and are compared with those obtained from previous work on Au nano-islands thin films. It was found that increasing the polymer/Au ratio resulted in decrease of the nonlinear response due to decrease of nanoparticles content. Moreover, the samples were found to exhibit strong self focusing or defocusing behaviour depending on the duration of the excitation laser pulse. The influence of the size of Au cluster on the nonlinear response is also investigated.

ABSTRACT: MN157

The properties of the nanometer thick Si/Ge films-on-insulator produced by Ge^+ ion implantation and subsequent hydrogen transfer

Ida E. Tyschenko[1], Matthias Voelskow[2], Alexander G. Cherkov[1], & Vladimir P. Popov[1]

[1]Institute of Semiconductor Physics, Russian Academy of Science, Novosibirsk, 630090, Russia, e-mail: tys@isp.nsc.ru,
[2]Institute of Ion Beam Physics and Material Research, 01314 Dresden, Germany

The ability of germanium to segregate at the Si/SiO_2 interface as a result of high-temperature heat treatments in an oxidizing atmosphere and to form thin epitaxial layers has great practical importance from the standpoint of forming silicon–germanium structures on an insulator. The importance of the formation of these structures is caused by the need for an increase in mobility in the nanometer length channels of MOS transistors. At the present work, the structural and electrical properties of the Si/Ge heterostructures-on-insulator produced by Ge^+ ion implantation into the thermally-grown SiO_2 layers and subsequent hydrogen transfer of thin Si film on the ion-implanted substrate have been investigated as a function of the subsequent annealing temperature. The thickness of the top silicon layer was in the range from 1 to 30 nm. For comparison, the respective silicon-on-insulator (SOI) structures without germanium were prepared too. High resolution electron microscopy and Rutherford backscattering spectrometry were employed to the investigation of the structural properties of the samples. In order to study the effect of Ge on the carrier mobility in the top nanometer-thick silicon films, a special Hall structures were formed on the Ge-ion implanted and unimplanted SOI samples.
The formation of Ge nanocrystal in the buried SiO_2 layer was observed from the ion-implanted structures annealed at the temperatures before 1100 ^oC. No germanium nanocrystals in the buried SiO_2 was formed as annealing temperature achieved T_a = 1100 °C. The implanted Ge atoms segregate to the Si/SiO_2 bonding interface. In this case, Ge atoms are found at sites that are coherent with the lattice of the top silicon layer. Under these conditions, an increase in the hole mobility by a factor of 2-3 was observed in Si/Ge layers in comparison with that shown in the respective SOI films without germanium.

SESSION 9: MATERIALS, DEVICES & APPLICATIONS

ABSTRACT: MN136

Molecular Nanodevices based on Functionalized Cyclodextrins

D. Velessiotis[1], D. Maffeo[2], E. Makarona[1], V. Chinnuswamy[1], C. Milios[3], K. Yannakopoulou[2], I. Mavridis[2], Z. Pikramenou[3], N. Glezos[1]

[1] Instit. of Microelectronics, NCSR Demokritos, Athens, Greece, [2] Instit. of Physical Chemistry, NCSR Demokritos, Athens, Greece, [3] School of Chemistry, Univ. of Birmigham, Edgbaston, UK, e-mail: dveles@imel.demokritos.gr

Molecular electronics has been proposed for the construction of future electronic devices. Potentially, the smallest operating element in such a device can be a single molecule, producing systems of ultra high integration. Nowadays, the most promising layout for construction of a molecular device is the attachment of the molecule to the device by the use of a self-assembled monolayer (SAM).
Cyclodextrins (CDs) are cyclic oligosaccharide structures of torus-like shape. Their main characteristic is the ability to form host-guest complexes with a very wide range of molecules, having thus a variety of different uses. Based on this ability, we investigate, here, the potential of CDs to be used as active components in molecular devices.
We electrically characterize a planar nanodevice with gold electrodes in the nanometer scale, fabricated by a conventional lift-off process, functionalized by a suitably synthesized cyclodextrin SAM. The SAM can be supramolecularly connected with suitably modified gold nanoparticles, so that the electrodes are bridged. Thus, conductive paths through single molecules (Au contact/molecule/Au bridge/molecule/Au contact) are formed. In order to study the electrical behavior of the systems concerned, different arrangements are used, varying in the CD derivative exploited, the way this molecule is connected to the underlying gold surface and the non-covalent association of the gold nanoparticles with the SAM. Hysterisis effects which are of primary interest for the fabrication of molecular memory devices depend upon the electrode distance, the type of the CD complex, the type of the guest molecule and the size of the gold nanoparticle. The transport properties of CD SAMs are also investigated by STM I-V spectroscopy. It is proved that a CD complex containing Ruthenium has enhanced conductivity compared to the other complex used. Furthermore, STM and AFM methods provide us with valuable topography information concerning surface coverage and molecular arrangement.

ABSTRACT: MN62

Electronic structure investigation of Nickel Phthalocyanine thin film interfaces with inorganic and organic substrates

Foteini Petraki & Stella Kennou

Department of Chemical Engineering, University of Patras and FORTH/ICE-HT, Rion, Patras, Gr-26504, Greece,
e-mail: petraki@chemeng.upatras.gr

Recently there is a great interest for application of organic semiconductors thin films as active layers in electronic devices. A lot of effort is devoted to the improvement of the device performance. The electronic structure of organic/metal and organic/organic interfaces determines the charge injection at the interfaces and so it plays a crucial role in the efficiency of such devices. Metal Phthalocyanines (MPcs) present beneficial properties such as quite high conductivity, thermal and chemical stability, compatibility with plastic substrates and low cost of deposition processes and they are already used in gas sensor technology and in electronic devices. Among them Nickel Phthalocyanine (NiPc) proceeds the highest carrier mobility. In the present study, the electronic structure of the formed interfaces between ultra thin film of NiPc and inorganic (Au, Ag, ITO, Si) and organic (PEDOT:PSS) substrates was investigated by X-ray and UV-Photoelectron Spectroscopies (XPS, UPS). The experimental results show that NiPc interacts chemically with Si(111) substrate, while it forms abrupt interfaces with metals (Au, Ag) and ITO. In the interface formed with the organic substrate a pinning of the Fermi level was observed. The hole injection barrier was determined in all interfaces and it appears to be independent of the work function of the substrate in the case of the abrupt interfaces. Whereas for the interface formed with the PEDOT:PSS a significant decrease of the hole injection barrier was observed than on Au, although the two substrates have a similar work function. All the investigated systems divert from the Schottky-Mott rule and the observed interfacial dipoles seem to increase as the work function value of the substrate increases. The experimental results showed that NiPc can be used as active layer in thin organic film devices, while the interface of NiPc with PEDOT:PSS exhibits the best electronic structure for an efficient charge injection.

ABSTRACT: MN2

Covalent Grafting of Glycine onto the Porous Silicon Surface

S. Sam[1, 3], A. C. Gouget-Laemmel[2], J-N. Chazalviel[2], F. Ozanam[2], N. Gabouze[1], S. Djebbar[3]

[1] UDTS, 02, Bd. Frantz Fanon, B.P. 140 Alger-7 merveilles, 16200 Algiers, Algeria
[2] LPMC, CNRS-Ecole Polytechnique, Route de saclay, 91128 Palaisau, France
[3] USTHB, B.P. 32 El Alia, Bab Ezzouar, Algiers, Algeria
E-mail : banasprit@yahoo.fr

One of the most exciting applications of porous silicon is that of a sensing material for a whole range of different analyte classes (bio- and chemical sensing). While initially the photoluminescence emission was used as the transduction event, new approaches exploiting other properties of the nanocrystalline architecture of the material are especially promising, such as electrochemical strategy (potentiometric and capacitance). Advances in techniques of chemical functionalization of porous silicon have increased the material stability and introduced new ways of organic molecules grafting to silicon via stable and covalent bonds. Hydride terminated porous silicon surfaces are reactive enough to allow for a wide range of chemistry, thus a variety of functional groups can be anchored to the surface upon demand. On the other hand, amino acids are known to be usable as recognition elements for electrochemical metal ion sensing. In this work, we report a three-step route to Glycine and Glycine ester grafting onto the porous silicon surface. The first step consists in thermal hydrosilylation of undecylenic acid with hydrogen terminated porous silicon surface at 150°C. It yields an organic monolayer covalently attached to the surface through Si-C bonds. The reaction takes place at the terminal C=C double bond of the molecule and the acid terminal groups remain intact. In the second step, the carboxylic-acid terminated monolayer was transformed to a succinimidyl ester. This activation was achieved using *N*-hydroxysuccinimide (NHS) and *N*-ethyl-*N*'-(3-dimethylaminopropyl)carbodiimide (EDC) as a coupling reagent. Finally, the amino acid was attached to the monolayer, by reacting with the activated ester. The reaction efficiency at each stage of the functionalization was confirmed using FTIR measurements. SIMS depth profiling showed a consistent level of carbon incorporation throughout the porous silicon. Electrochemical behaviour of the Glycine modified porous silicon in the presence of copper ions was studied by means of cyclic voltammetry measurements.

Keywords: Porous silicon, Glycine, Functionalization

ABSTRACT: MN154

APPLIED NANOIONICS OF ADVANCED SUPERIONIC CONDUCTORS

A.L.Despotuli, A.V.Andreeva

Instit. of Microelectr. Technol.&High-Purity Mater. Russian Academy of Sciences 142432 Chernogolovka, Moscow District, Russia

Nanoionics is a rapidly developing direction in nanoscience & nanotechnology. The subject of nanoionics is new phenomena, properties, effects, mechanisms of processes and applications connected with the fast ionic transport (FIT) in solid ionic nanosystems (NS) [1-3]. The main field of applied nanoionics is the creation of new materials, functional structures and devices for storage and conversion of energy and the information. The term and conception of "Nanoionics" was first introduced in [4] and the general description of nanosystems on a basis of dimensionless parameter (P) is proposed $P = \lambda/L \sim 1$, where L is the dimension of nanosystem (subsystem of complex system), and λ is the nanolength along which the phenomenon, property, effect or mechanism of the process connected with FIT is realized. According classification of different types of solid-state ionic conductors [5] a new class of materials –advanced superionic conductors (AdSICs) is distinguished; AdSICs are solid electrolytes with a very high level of unipolar ionic conductivity ($\sigma_i \geq 0.01$ $Ohm^{-1}cm^{-1}$), a very low level of electronic conductivity ($\sigma_i >> \sigma_e$), and a low activation energy E is ≈ 0.1 eV. The crystal structure of AdSIC is close to optimum one for FIT with "channels" for moving ions, but it is disturbed at arbitrary boundaries (sharp decrease of σ_i and increase of E). In [5] a new scientific & technological discipline - "Nanoionics of advanced superionic conductors" was introduced. Fundamental challenge of nanoionics of AdSICs is conservation of FIT in NS of AdSICs. Crystal chemistry & interface engineering methods at nanoscale allows to find the conditions and materials for synthesis of structure-ordered (coherent) AdSIC//EC (EC is an electronic conductor) interfaces with FIT in double electric layers [6]. A coherent heterojunction provides conditions for FIT in double electric layer (DEL) at the interface and capacitors with these heterojunctions have been called nanoionic supercapacitors (NSC) [1] with record high characteristics (capacity ~10^{-4} F/cm^2, operation frequency ~10^8 Hz) [2,3].The NSC and AdSIC are expected to be of great technological and commercial advantage and may be used in many important challenges. The R&D in the area of applied nanoionics of AdSICs are: high capacity capacitors for 0.5V and more deep sub-voltage nanoelectronics, capacitors for extreme electronics (space, deep drilling, etc.), new nanoionic devices for silicon, molecule, "nanowire" and graphene electronics, atomic quantum switches (AQS) for high density memory, the microrelay on the basis of AQS matrixes, energy & power sources for nano-and microsystem technology, wireless sensor networks, electronics of ultra dense surface mount (SMD), etc.

REFERENCES

1. Despotuli A.L., Andreeva A.V. "Creation of New Type Thin-film Supercapacitors for Microsystem Technology and Micro(nano)electronics", Microsystem technol. (Rus), № 11, pp.2-10, №12, pp.2-5, 2003
2. Despotuli A.L., Andreeva A.V. "Supercapacitors for Electronics", Modern electronics (Rus), №5, pp. 10-14, №6, pp.46-51, 2006
3. Despotuli A.L., Andreeva A.V., Vedeneev V.V., Aristov V.V., Maltsev P.P. "High-capacity capacitors for ultra-dense surface mount", Nano-Microsystem Technology (Rus), № 3, pp. 30-37, 2006
4. Despotuli A.L,, Nikolaichik V.I. "A Step Towards Nanoionics", Solid State Ionics, 60, pp.275, 1993
5. Despotuli A.L., Andreeva A.V., Rambabu B. "Nanoionics of Advanced Superionic Conductors", Ionics, 11, pp. 306-314, 2005
6. Andreeva A.V., Despotuli A.L. "Interface design in nanosystems of advanced superionic conductors", Ionics, 11, pp.152-160, 2005

ABSTRACT: MN67

Energetic calculations of the AlN/GaN interface

E. Kalessaki, J. Kioseoglou, G. P. Dimitrakopulos, Ph. Komninou*, and Th. Karakostas

*Depart. of Physics, Aristotle University of Thessaloniki, GR-54124, Greece, *email: komnhnoy@auth.gr*

Epitaxially grown thin films yield interface structures which correspond to the orientation relationship between the crystal lattice of the epilayer and the substrate. These structures are defined by a minimum of total energy of interfacial configuration and are usually characterized by high lattice mismatch. In the present work the structural and energetic characteristics of AlN/GaN (0001) interfaces were studied by performing both ab initio methods and Tersoff interatomic potential calculations. The later describes sufficiently the metallic and intermetallic interactions and is assembled in order to accurately reproduce the lattice and elastic parameters of wurtzite group III-nitrides. In either case various configurations were examined depending on polarity (III or N) and the interfacial structure (wurtzite or sphalerite). In the case of ab initio study we pseudomorphically matched the lattices by imposing the average basal lattice constant of bulk AlN and GaN to the AlN/GaN superlattice. The role of polarity on the interfacial energy is justified in both case studies. It is shown that III-polarity interfaces are more favorable than those of N polarity. From ab initio calculations we were also able to distinguish between wurtzite and sphalerite interfacial structures. Wurtzite and sphalerite interfaces are almost energetically degenerate with wurtzite slightly preferable with respect to the sphalerite interfacial structure.

Acknowledgement: This work was supported by the EU under the contract MRTN-CT-2004-005583 (PARSEM).

ABSTRACT: MN58

Enhanced efficiency of narrow InGaN/GaN quantum wells

S.-L. Sahonta, Ph. Komninou[1], G.P. Dimitrakopulos, Th. Karakostas, C. Salcianu[2] and E.J. Thrush[2]

[1]Department of Physics, Aristotle University of Thessaloniki, 54124 Thessaloniki, Greece, [2]Thomas Swan Scientific Equipment Ltd., Buckingway Business Park, Swavesey, Cambridge, CB4 5FQ, United Kingdom, [1]e-mail: komnhnoy@auth.gr

Blue light-emitting diodes (LEDs) grown on silicon (111) substrates, consisting of five MOVPE-grown narrow wurtzite $In_{0.2}Ga_{0.8}N$ quantum wells (QWs) of nominal thickness 2 nm, have been shown by HRTEM to contain a highly defective active region, despite exhibiting high internal quantum efficiency. Carrier localisation in InGaN QWs is usually attributed to phase separation, giving rise to In-rich clusters which behave as quantum dots, preventing carriers from migrating to non-radiative centres such as threading dislocations [1,2]. However there is no evidence of large-scale In clustering in the specimens examined here, thus alternative mechanisms of carrier confinement are considered. The possible role of the defects themselves in localising excitons, therefore enhancing emission efficiency, is discussed.

Photoluminescence studies show that the room temperature internal quantum efficiencies of the QWs are approximately 20%; relatively high for GaN-based LEDs grown on silicon. This is unexpected, as HRTEM imaging reveals that the QWs contain gaps ranging between 10 nm and 50 nm in length, which isolate separate regions of well of similar dimensions to the gaps. Also observed throughout the QWs are stacking faults, sphalerite stacking and thickness fluctuations. These defects however do not appear to result in a significant reduction in luminescence emission from the device. Moreover, no evidence of extensive In phase separation has been observed, hence alternative mechanisms of carrier confinement via the defected discontinuous QW structure are accounted for. The stacking faults and sphalerite regions do not induce electronic states in the band gap [3], so are not expected to have a detrimental effect on the device efficiency. It is proposed that the regions of InGaN separated by gaps behave as *quantum boxes* in which carriers are physically confined, enhancing radiative recombination. In addition, monolayer variations in well thickness can relegate carriers to wider regions of the QWs, contributing to their localisation.

[1] I. Ho and G.B. Stringfellow, Appl. Phys. Lett., 69, 2701 (1996)
[2] N. El-Masry *et al.,* Appl. Phys. Lett., 72, 40 (1998)
[3] C. Stampfl and C.G. Van de Walle, Phys. Rev. B, 57, 24, LII-LV (1998)
This work was supported by the EU under the contract MRTN-CT-2004-005583 (PARSEM)

SESSION 10: SEMICONDUCTORS DEVICES & APPLICATIONS IN LIFE-SCIENCES

INVITED TALK I9

Electrical Transport Through Self-Assembled Hydrophobin Protein Membrane

J. Kivioja[1], J. Ahopelto[1], K. Kurppa[2], A. Paananen[2], G. Szilvay[2] and M. Linder[2]

[1]VTT Micro and Nanoelectronics, Tietotie 3, FI-02150 Espoo, Finland
[2]VTT Nanobiomaterials, Tietotie 2, FI-02150 Espoo, Finland

We report on transport properties of ordered single layer protein crystals on graphite substrate. The hydrophobin proteins form an ordered two-dimensional crystal at air-water interface with the protein molecules all having a well defined orientation and position. From the air-water interface the crystal membranes are transferred onto surface of highly oriented pyrolytic graphite. The ordered structure allows for a well-controlled electrical measurement with information about the alignment of the molecules on the surface. The measurements are carried out using a conducting atomic force microscope (AFM) setup, which can provide simultaneously the topography and conductance maps. The I-V curves show reproducible sharp resonances. The conductance through the proteins is changed when applying pressure, thus providing information about the conformational changes within the molecules. The protein membrane can potentially form a building block for a bio-non bio interface.

INVITED TALK I10

Nanotechnology Advances in Controlled Drug Delivery Systems

Costas Kiparissides

Department of Chemical Engineering, Aristotle University of Thessaloniki and Chemical Process Engineering Research Institute, P.O. Box 472, 54124 Thessaloniki, Greece, cypress@cperi.certh.gr

Nanomedicine is defined as the application of nanotechnology to achieve breakthroughs in healthcare. It exploits the improved and often novel physical, chemical and biological properties of materials at the nanometer scale. At this scale, manmade structures match typical sizes of natural functional units in living organisms thus allowing them to interact with the living organisms. Nanomedicine has the potential to enable early detection and prevention, and to essentially improve diagnosis, treatment and follow-up of diseases (e.g., combination of diagnostic devices and therapeutics (theranostics) with a real benefit for patients). Nanomedicine is a very special area of nanotechnology, because: (i) it is an extremely large field ranging from in vivo and in vitro diagnostics to therapy including targeted delivery and regenerative medicine, (ii) it interfaces nanomaterials with "living" human material and (iii) it creates new tools and methods that impact significantly existing conservative practices.
Nanotechnology advances in drug delivery deal with the development of synthetic nanometer sized targeted delivery systems for therapeutic agents of increased complexity, and biologically active drug products. Therapeutic systems in this class are up to a million times larger than classical drugs like aspirin. Being larger there is more scope for diversity and complexity, which makes their description much more challenging and their delivery more difficult. Their increased complexity however, gives these systems the unique power to tackle more challenging diseases. Targeted delivery systems can have multiple functions, a key one being their ability to recognize specific molecules which can be located either in the membrane of target cells, or in specific compartments within the cell. A challenging objective of targeted drug delivery is the development of innovative multidisciplinary approaches for the design, synthesis and functionalization of novel nanocarriers for targeted delivery of P/P drugs via oral, pulmonary and Blood Brain Barrier (BBB) crossing administration routes.

ABSTRACT: MN189

Micro- and Nano-particle manipulation by joint Dielectrophoresis and AC Electroosmosis: Devices for particle trapping utilizing both phenomena

N G Loucaides[1], A Ramos[2] and G E Georghiou[1]

[1] University of Cyprus, Department of Electrical and Computer Engineering, [2] University of Seville, Department of Electronics and Electromagnetism, email: eep4nl1@ucy.ac.cy

There has been a lot of research interest recently in the enhancement of the concentration of bioparticles in sensor devices using both ACEO and DEP, so that the end effect is better than if each method alone is used [1]. Such devices are expected to utilize the advantages of both AC Electroosmosis (ACEO) (longer reach into the fluid solution) and Dielectrophoresis (DEP) (very strong localized forces) to produce novel systems that will effectively allow the controlled manipulation and trapping of nanoparticles.
Investigations into the stability of nanoparticle traps formed in parallel electrode arrays by joint DEP and ACEO have shown that it is possible to form trapping zones that can be either stable or unstable depending on various parameters, one of which is the applied electric field [2] [3]. The current state of the art uses combined ACEO with DEP [4] [5] [6] or combined Electrothermal with DEP [7] [8] to produce enhancement of particle concentration.
In this paper, nanoparticles immersed in a solution over an array of electrodes are investigated. The use of both ACEO and DEP in a system of configurable asymmetries is investigated, in order to devise a method of particle manipulation that will allow not only the trapping of particles at one predetermined location but also at several locations at will, depending on the level of the electrode excitation [9].
Finally, the effect of several parameters of the system on the operation such as the electrode dimensions and the particle size is investigated. Based on the findings, suggestions are given for improved system performance.

References

[1] Bown M R and Meinhart C D *2006 Microfluidics and Nanofluidics Journal 2(6) 513–523*
[2] Tuval I, Mezic I, Bottausci F, Zhang Y, MacDonald N and Piro O *2005 Phys. Rev. Lett. 95 236002*
[3] Skytte T, Skafte-Pedersen P and Pedersen M *2006 Particle manipulation in microfluidics by ac electroosmosis and dielectrophoresis (Unpublished)*
[4] Hoettges K F, McDonnell M and Hughes M P *2003 J. Phys. D. 36 101–104*
[5] Hoettges K F, Hughes M P, Cotton A, Hopkins N A E and McDonnell M B *2003 Engineering in Medicine & Biology Magazine, IEEE 22(6) 68 – 74*
[6] Zhou H, Lee W and Robert T *2005 Journal of colloid and interface science 285(1) 179–191*
[7] Docoslis A, Espinoza L A T, Zhang B, Cheng L, Israel B A, Alexandridis P and Abbott N L *2007 Langmuir 23(7) 3840 – 3848*
[8] Wood J A, Zhang B, Tomkins M R and Docoslis A *Microfluidics and Nanofluidics Online first*
[9] Loucaides N, Ramos A and Georghiou G E *Microfluidics and Nanofluidics Online first*

ABSTRACT: MN139

Control of nano-topography and wetting properties of polymers: application in PMMA and PDMS

N. Vourdas, M.-E. Vlachopoulou, A. Tserepi, E. Gogolides

Institute of Microelectronics, NCSR "Demokritos", Aghia Paraskevi 15310, Greece, e-mail: nvourdas@imel.demokritos.gr

Wettability control is of great importance in many applications, from manufacturing of water repellent surfaces to droplet frictionless motion in microfluidics. Wetting or water repellent behaviour is governed by both surface chemistry and topography. In particular, super-hydrophobicity (SH) is attained by combining low surface energy coatings and high-aspect-ratio (HAR) geometrical characteristics. Liquids contact only the upper part of HAR surfaces in a state called Cassie-Baxter. In this study we present a novel, simple, generic and fast technique to nano-texture and fabricate stable SH, yet transparent poly(methyl methacrylate) (PMMA) and poly(dimethyl siloxane) (PDMS) surfaces by means of high-density plasma etching and deposition [1,2].

An Inductively Coupled source is used to generate cold plasma within a low-pressure reactor (MET, Alcatel) which is used to treat the PMMA and PDMS surfaces. First O_2 based plasma for the case of PMMA, and SF_6 plasma for the case of PDMS, is applied to etch the surface and create surface roughness, with controlled characteristics. The time of the process may differ from 1 min to several min depending on the roughness amplitude and on the degree of transparency desired. Pressure and bias voltage effect on HAR morphology is also explored and discussed. After this first step the gas chemistry is altered into a fluorocarbon one, for both PMMA and PDMS, which leads to a Teflon-like deposition and controlling thus the surface chemistry. Following this process SH surfaces are produced.

AFM and SEM are used to characterize morphology and water contact angle (CA) and CA hysteresis to characterize wetting properties. We demonstrate high aspect ratio pillars with height ranging from ca. 350 nm to several microns depending on the processing time, and contact angles of 150° with hysteresis lower than 10° within 1 min of plasma processing. Surfaces with pillars shorter than 400 nm are simultaneously transparent.

[1] Tserepi A., Vlachopoulou M.-E., Gogolides E. 2006 Nanotechnology 17 3977
[2] Vourdas N., Tserepi A., Gogolides E. 2007 Nanotechnology 18 125304

SESSION 11: MONOLITHIC INTEGRATION ON Si SUBSTRATES

ABSTRACT: MN60

Broadband Electrical characterization of Porous Silicon at Microwave Frequencies

H. Contopanagos, D. Pagonis and A. G. Nassiopoulou

IMEL/NCSR "Demokritos", P.O. Box 60228, 153 10 Aghia Paraskevi, Athens, Greece, e-mail: contopan@imel.demokritos.gr

Porous Silicon is an appropriate material for producing RF isolation of analog devices integrated on-chip in a CMOS-compatible process, operating at microwave frequencies. We present results of electrical characterization of porous silicon using a macroscopic platform where the die containing the porous silicon layer and a highly-doped silicon substrate is inserted directly underneath a microstrip line. The porous silicon used was macroporous with vertical cylindrical pores of average diameter 120 nm and it was fabricated on a selected area on the Si substrate (RF microplate). Its thickness was 50 μm and lateral dimensions 2cm×1.5cm. It was fabricated by anodization of p+ Si (resistivity 5 mΩ.cm) in an HF-ethanol electrochemical solution. We measured the scattering parameters of the system and then simulated the platform using a commercial finite-element full-wave electromagnetic solver. The p+ silicon substrate of very low resistivity used acts as a lossy metal ground for the microstrip. We have chosen a broad frequency band extending from low frequencies (40MHz) up to and including the first harmonic of the transmission line (6GHz). By identifying measured and simulated S-parameters over the whole frequency band we can extract both geometrical characteristics of the measurement set-up not accessible to direct measurements and the complex permittivity of the porous silicon layer. Since the Si die with the porous silicon RF microplate that was characterized was inserted directly underneath the transmission line in as close a contact as possible, a most important such geometrical feature is the air gap between the line and the sample surface. This air gap drives the mid-band values of the S-parameters and can therefore be extracted from the results in that frequency range. The complex permittivity of the material, on the other hand, fixes the frequency position and S-parameter values of the first harmonic of the system, occurring at the half-wavelength resonance. The results showed a total RF loss of the specific porous silicon RF micro-plate measured of 18%-25% at 1-2.5GHz, a dielectric constant of 4.9 and a loss tangent of 0.15.

ABSTRACT: MN77

Low energy loss rf circuits on nanostructured porous silicon layers

A. Porcher*, B. Remaki, C. Malhaire and D. Barbier

INL (UMR CNRS-INSAL 5270), Université de Lyon / INSA de Lyon, Bat. 502, F-69621 Villeurbanne cedex, France
* e-mail: arnaud.porcher@insa-lyon.fr, Phone: +33 472.43.83.27, Fax: +33 472.43.60.82

The improvement of radio-frequency (rf) devices in terms of resolution and signal treatment performances make essential the emergence of integrated solutions. Conventional silicon technology approach is limited by severe energy losses in the Si substrate and hybrid circuits realizations are then prevailing. Recently, nanostructured porous silicon (PS) has been regarded as an attractive thick insulator wich can be inserted under the rf devices to reduce the losses in the substrate. Indeed, PS exhibits interesting dielectric properties with an excellent ability to be micromachined in layer of few hundreds µm using a full compatibility process with CMOS integration technology.
Here, we have investigated the characteristics of LC resonant circuits designed on thick porous silicon layers. The rf analysis were performed on planar circuits based on micro-coils made with Au lines and thermal S_iO_2 tuning capacitances. The effective dielectric insulation, insured by PS tub of 100 µm of thickness, reduces the distributed capacitance (under the inductance lines) to a negligible value. Thus, the tuning capacitance is adjusted by the area of the central mono-crystalline Si shunt in order to control the resonating frequency.
Experimental data combined with numerical simulations have shown interesting capabilities of porous silicon to reduce the energy loss in rf L-C circuits in the 10^7 – 10^9 investigated frequency range. Thermal oxidation of PS layers even at moderate temperatures enhances its insulating properties. This study is completed using numerical simulations in order to determine the contribution of the residual PS conductance (due to the hopping transport) to the total rf losses.

Keys Words: porous silicon, rf devices, electrical transport, complex impedance analysis.

ABSTRACT: MN151

High-frequency scalable compact modelling of Si RF-CMOS technology

Antonios Bazigos[1], Matthias Bucher[2], Paulius Sakalas[3], Michael Schroter[3]

[1]National Technical University of Athens, GR 15780 Athens, Greece
ampazig@elab.ntua.gr
[2]Technical University of Crete, GR 73100 Chania, Greece
bucher@electronics.tuc.gr

[3]Technical University of Dresden, D 01069 Dresden, Germany
{*sakalas* schroter}@iee.et.tu-dresden.de

Modern deep submicron CMOS technologies offer record transit frequencies well above 100GHz while using ever lower supply voltages. Efficient RF circuit design employing such technologies is based on ever more complex compact models for circuit simulation, that describe precisely the nonlinear, analogue behavior of the MOSFETs up to high frequencies. EKV3 is an advanced, scalable MOSFET compact model based on the charge-sheet theory, which uses a unified equation set to describe static to high-frequency behavior in all operating regions. The model has been verified against many advanced CMOS technologies with drawn gate lengths down to 65nm and has shown excellent fitting results.
An extended number of RF devices were fabricated in an 180nm CMOS technology. DC and S-parameters were measured. Figure 1 shows static characteristics – drain current I_D, transconductance and output conductance g_m and g_{ds}, as well as transconductance-to-current ratio g_m/I_D – of a multi-finger NMOS transistor. The EKV3 model shows excellent fits of all the static characteristics. Figure 2 shows the four Y-parameters, derived from S-parameter measurements from 50MHz to 30GHz, for the same device. The latter results are obtained after a careful OPEN and SHORT de-embedding procedure. Bias conditions – the device is biased in saturation – cover weak to moderate and strong inversion. The real parts of Y_{21} and Y_{22} correspond to g_m and g_{ds}, respectively, at low frequency. The EKV3 model shows adequate fitting and scaling behavior over the whole bias and frequency ranges.

The paper will furthermore discuss questions of layout and effects of scaling of the multi-finger RF structures as well as parasitics modelling. Further results, including evaluation of transit frequency, maximum oscillation frequency, unilateral gain versus bias current, will be discussed.
In conclusion, extended measurement results in a deep-submicron CMOS technology and RF performance of an advanced compact MOSFET model for analogue/RF IC design are presented.

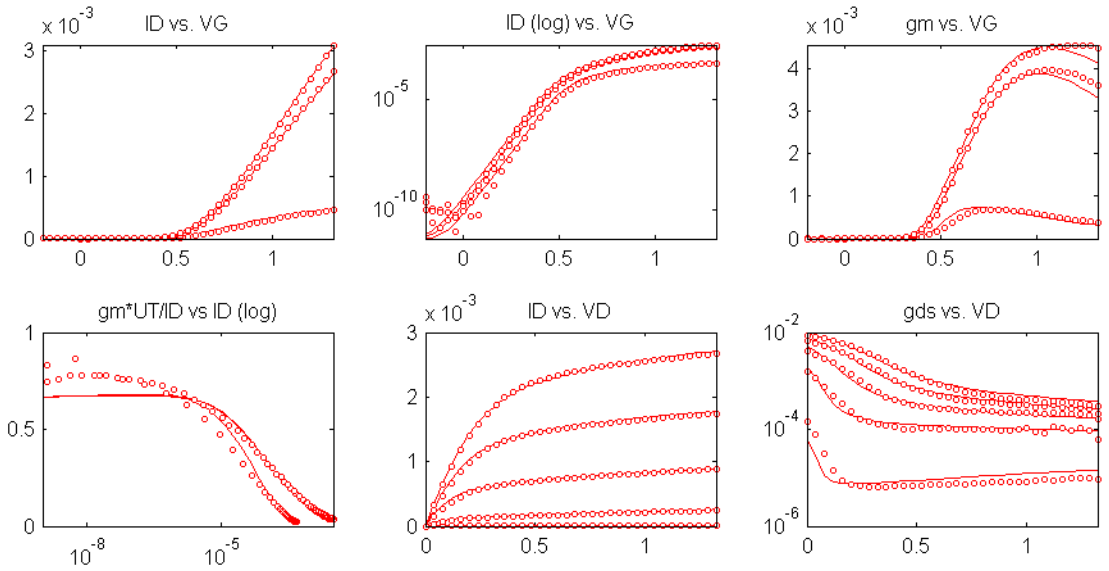


Figure 1. Static characteristics, NMOS transistor, L=180nm, W=2um, NF=4: I_D and g_m vs. V_{GS}, g_m/I_D vs. I_D (V_{DS} = 0.05, 0.5, 1V), I_D and g_{ds} vs. V_{DS}, (V_{GS} = 0.2, 0.4, 0.6, 0.8, 1V), measured (markers) and simulated with EKV3 model (lines).

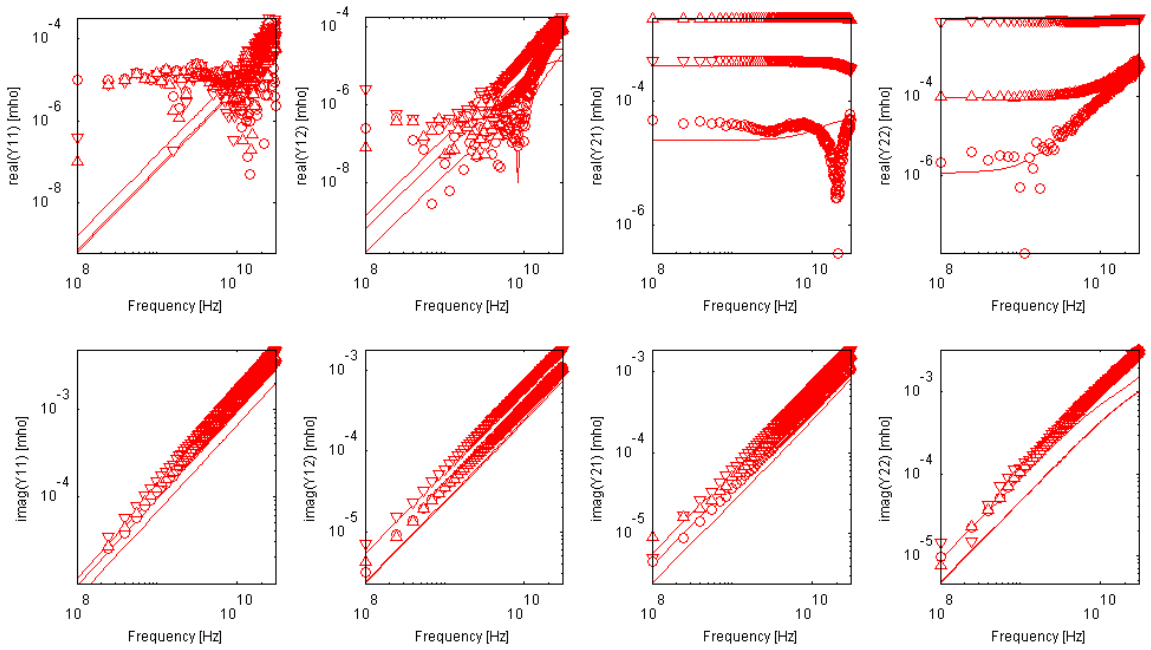


Figure 2. Y-parameters vs. frequency, NMOS transistor, L=180nm, W=2um, NF=4, measured (markers) and simulated with EKV3 model (lines): V_{DS} = 1V; V_{GS} = 0.3 (▼), 0.6 (o), 1.2 (▲) V.

ABSTRACT: MN110

Semiconductor neuronal nanofibers for parallel computation

A. Samardak[1], S. Taylor[1], A. Nogaret[1], G. Hollier[2], J. Austin[2], D. Ritchie[3]

[1]Department of Physics, University of Bath, BA2 7AY, UK, A.Samardak@bath.ac.uk
[2]Department of Computer Science, University of York, YO10 5DD, UK
[3]Cavendish Laboratory, University of Cambridge, CB3 0HE, UK

We propose a spatially structured artificial neuronal nanofiber that is able to compute the phase difference introduced by its dendrites, in agreement with a universal diffusion equation. From a technological standpoint, our artificial nanofiber is the first active device specifically designed for parallel spike computation. It solves the key issues of signal transmission, neuronal coding and synaptic plasticity that allow one to build pulse-timing networks.
We have fabricated nanofibers based on two GaAs pn junctions grown by molecular beam epitaxy. The donor and acceptor doping concentrations were $N_A=N_D=5\cdot10^{22}m^{-3}$ (low doped) and $N_A=N_D=5\cdot10^{23}m^{-3}$ (high doped). The n- and p-type electrodes formed thin metallic strips on both sides of the depletion layer. Novel lithography, etching and deposition techniques were then implemented to fabricate the nanofibers with a freestanding pn nanowire. The thicknesses of nanowire are 360 nm and 140 nm for low and high doped structures respectively.
The spike amplitude was seen to decay exponentially on a length scale of 2-4 mm corresponding to the theoretical diffusion length. Pulse velocities of 5-20 km/s were observed in the range 100 kHz - 10 MHz. We have applied digital pulse trains at opposite ends of the nanofiber to measure their interferences at intermediate points of the composite structure. Spike trains arriving in phase at a given node interfered with the resulting amplitude equalling the sum of the two individual pulses measured separately at the respective node. By contrast, the positive and negative spike trains in phase interfered with the resulting amplitude being close to zero.
In summary, pn nanofibers were shown to act as transmission delay lines and to perform the spatio-temporal integration of multiple spike trains. These results make possible spike timing artificial neurons for parallel computation based on spike trains.

ABSTRACT: MN196

Monolithic integrated microring resonators: The fundamental building block towards "Dense" photonic integration

Spiros Mikroulis, and Dimitris Syvridis

Department of Informatics and Telecommunications, University of Athens, Panepistimiopolis Illisia, Athens, Greece, e-mail: spirosm@di.uoa.gr

Semiconductor microring resonators are excellent fundamental building blocks for fabrication of Optoelectronic Integrated Circuits (OEICs). They enable large third-order nonlinearities enhanced by the resonance effect, which can be used for all-optical signal processing functions, while their compactness can lead to ultrahigh device integration densities. Moreover, they are promising candidates for optical transmitters due to their significantly higher spectral purity compared to standing wave lasers (traveling wave nature of the device), combined with simple fabrication due the absence of cleaved facets or Bragg gratings.
The fundamental configuration is based on the fabrication of a circular and a straight waveguide evanescently coupled. Two alternative approaches can be utilized, the lateral coupling scheme, where both the circular and the straight section are in the same epitaxial layer and the lateral coupling scheme where the circular and the straight section are in different epitaxial layers. In the former approach the coupling gap can be fabricated by lithography and etching and in the latter by simple epitaxial growth. The fundamental design parameters which control the overall performance of a microring-based photonic function are the coupling strength, the radius and the waveguide losses. The coupling strength can be controlled by varying the coupling gap and/or the radius, and the waveguide losses by the waveguide roughness and curvature (radius).
The key role of the above mentioned design parameters will be highlighted for applications in novel photonic functions like wavelength conversion, all-optical regeneration, all-optical logic, and information transmission and the dependence of each device's performance on the above parameters will be analyzed.
In conclusion, microring resonators are compact photonic units capable to provide multiple optical functions which can be combined on a single chip without complicated processing and optoelectronic assembly.

SESSION 12: POLYMERIC MATERIALS AND DEVICES

INVITED TALK I11

Molecular nanotechnologies for plastic organic/biologic devices

R. Cingolani

National Nanotechnology Laboratory - Lecce, Italian Institute of Technology – Genova, Italy

Novel cross-disciplinar nanofabrication methods applied to organic and biological materials have boosted the development of new classes of plastic nanodevices and miniaturized systems.
Unprecedentedly accurate control of the materials properties and of the nanofabrication technologies is accomplished by using hybrid organic/inorganic and biologic/inorganic systems, and by developing soft- and bio-compatible lithographies.
A few relevant examples/demonstrators will be presented during the talk, namely:
-fully plastic lab-on-chip devices for biodiagnostic and genomic applications,
-plastic light generators, solar cells and displays
-bioelectronic sensors , transistors and neuron networks.

ABSTRACT: MN44

Photoresponsive Polymer Surfaces*

S. H. Anastasiadis,[1,2] M. I. Lygeraki,[1] K. Lakiotaki,[1] M. Varda,[1] E. Tsiranidou,[1]
A. Athanassiou,[1,3] M. Farsari,[1] D. Pisignano,[3] and R. Cingolani[3]

[1] Institute of Electronic Structure and Laser, Foundation for Research and Technology-Hellas, 711 10 Heraklion, Crete, Greece
[2] Department of Chemical Engineering, Aristotle University of Thessaloniki, 541 24 Thessaloniki, Grecce
[3] National Nanotechnology Lab., INFM, CNR, 73100, Lecce, Italy and Italian Institute of Technology, Genova, Italy

Photochromic spiropyran molecules are utilized as additives for the development of polymer surfaces whose wetting characteristics can reversibly respond to irradiation with laser beams of properly chosen photon energy. The hydrophilicity is enhanced upon UV laser irradiation since the embedded non-polar spiropyran molecules convert to their polar merocyanine isomers, which is reversed upon green laser irradiation. Micropatterning of the photochromic-polymer films using soft lithography or photo-polymerization techniques affects their wettability towards a more hydrophobic or more hydrophilic behavior depending on the dimensions of the patterned features and on the hydrophilicity-hydrophobicity of the flat surface. The light-induced wettability variations of the structured surfaces are enhanced by up to a factor of three as compared to those on the flat surfaces. This enhancement is attributed to the photoinduced reversible volume changes to the imprinted gratings, which additionally contribute to the wettability changes due to the light-induced photochromic interconversions.

* Sponsored by the Greek General Secretariat of Research and Technology (PENED) and by NATO's Scientific Affairs Division

ABSTRACT: MN141

Photoinduced reversible diffraction efficiency of lithographic gratings on nanocomposite films containing photochromic molecules

Despina Fragouli, Dario Pisignano, Giovanni Paladini, Gianvito Caputo, Davide Cozzoli, Roberto Cingolani, Athanassia Athanassiou

NNL-National Nanotechnology Laboratory, INFM, CNR, Via Arnesano, 73100 Lecce, Italy, despina.fragouli@unile.it

We report a study of diffraction gratings, produced using soft molding lithography, on polymer films containing photochromic molecules in combination with TiO2 nanoparticles. Irradiation with alternating UV and visible laser light of the photochromic gratings causes reversible changes in the intensity of the transmitted and first diffracted beam of a diode laser (822nm), due to photochromic transformations. These changes affect the diffraction efficiency, which is increased upon irradiation UV and decreased after the irradiation with the visible laser light. The addition of nanoparticles to the polymer/photochromic systems allows the formation of gratings with high diffraction efficiency, and the achievement of the optical control of their diffraction properties. Such gratings show the potential for the fabrication of modern electro-optical components such as optical switching devices.

SESSION 13: NANOSTRUCTURES and CHARACTERIZATION TECHNIQUES

ABSTRACT: MN33

OPTICAL PROPERTIES OF SILICON BASED NANOSTRUCTURES

Amir Sa'ar

Racah Institute of Physics and the Center for Nanoscience and Nanotechnology, the Hebrew University of Jerusalem, Jerusalem 91904, Israel

In this presentation I will describe our recent progress in developing a comprehensive picture for understanding the optical properties, particularly the origin of the photoluminescence, from silicon based nanostructures such as nanocrystals, nanowires and porous silicon. Excitonic transitions in these nanostructures are split into radiative and nonradiative transitions with a reverse order for silicon nanowires. Lifetime measurements indicate that the high luminescence efficiency should be assigned to the *exclusion* of nonradiative channels rather than to the enhancement of radiative channels in these nanostructures. The above results are consistent with a model suggesting that the electronic states of these nanostructures are resonantly coupled to surface vibrations giving rise to long live surface polarons. Results of infrared photo-induced absorption spectroscopy, which provide further support to this picture, will also be described.

ABSTRACT: MN88

Nanocrystalization of Sm-Fe-Ta-N composites INSIDE magnetic nanodroplets from fast cooling on TAntalum surface

E. Sarantoupolou[1], J. Kovač[2], M. Janeva[3], Z. Kollia,[1] S. Kobe[4], G. Dražić[4], A. C. Cefalas[1]

[1]National Hellenic Research Foundation, TPCI, Athens, 11635 Greece.
[2]Josef Stefan Institute, Department for Surface
Engineering and Optoelectronics, Jamova 39, Ljubljana, Slovenia
[3]National Institute of Chemistry, Hajdrihova 19, 1000 Ljubljana, Slovenia
[4]Jozef Stefan Institute, Nanostructured Materials, Jamova 39, 1000 Ljubljana, Slovenia

Oxidization of magnetic thin films is a serious problem deteriorating magnetic film's properties. The growth of additional metallic protective layer on the top of the magnetic film adds additional complexity in magnetic film's fabrication. In this communication, bi-phase crystalline-amorphous nanodroplets were fabricated on Si-Ta substrates. The bi-phase structure consists of a 5-10 nm crystal nucleus surrounded by an amorphous phase. Nanocrystallization is taken place within the nanodroplet provided that fast cooling rate is established between the nanodroplet and the Ta substrate. The average size of the spherical droplet was 50-100 nm (depending on the distance between the target and the substrate). The amorphous external part of the nanodroplet prevents further oxidization of the inner crystalline magnetic structure and the oxidized external amorphous layer does not have any effect on the magnetic properties of the film. The coercivity of this type of nano-droplets/nanocrystals was 2.5 kOe. With further annealing and thermal restatement in nitrogen, the coercivity of the Sm-Fe-Ta-N film was further enhanced. We applied scanning transmission electron microscopy with high-angle annular dark-field detector (STEM/HAADF) imaging, together with other analytical techniques, to investigate the structure of Sm-Fe-Ta-N nanodroplets.

ABSTRACT: MN177

ANNA - Analytical Network for Nanotechnology

Massimo Bersani[1], Giancarlo Pepponi[1], Damiano Giubertoni[1]
and Jaap van den Berg[2]

[1] Fondazione Bruno Kessler - irst, via Sommarive 18, 38050 Povo (Trento), Italy
[2] Joule Physics Laboratory, Institute of Materials Research, University of Salford, Salford, M5 4WT, United Kingdom

ANNA (European Integrated Activity of Excellence and Networking for Nano and Micro-electronics Analysis) is an Integrated Infrastructure Initiative (I3) financed by the EC under the FP6. Its 12 partners (FBK-irst, FhG-IISB, ST, MEMC, NCSR-IMEL, MFA, UPAT, ATI, USAL, PTB, CNR, Intel), aim to the formation of a joint distributed analytical laboratory, able to provide analytical competence and services to companies, SMEs, universities, research institutes in the European Research Area, in the fields of microelectronics and nanotechnology.
Research and development of analytical techniques focuses on six main topics: highly sensitive detection of inorganic contamination, comprehension of organic contamination on wafer surface, accurate characterisation of ultra shallow junctions, nanofilms characterisation (in particular oxynitrides and high-k films), investigation of local strain at sub-micron scale, characterisation of nano-crystals. The consortium offers a wide range of complementary techniques promoting cross-comparison, standardisation and homogenisation of results to give the user more reliable and interpretable results. The techniques available are based on ion beams (MEIS, SIMS, ToF-SIMS), electron beams (SEM, TEM, STEM), electron spectroscopies (XPS), X-ray analyses (TXRF, XRR), optical analyses (spectroscopic ellipsometry, Makyoh topography) and electrical techniques. Moreover trace contaminants analysis techniques and two cleanrooms supporting the consortium with different sample preparation and treatment possibilities are available. The consortium is open to external users through a free Transnational Access program.
The project structure will be outlined and the activity and *modus operandi* of the consortium will be exemplified by a study on the characterisation of ion implants for the formation of ultra shallow junctions. The complementary information provided by SIMS, MEIS, TXRF, and electrical measurements allow a deeper understanding of the system and therefore an optimisation of the processes. In particular As ultra shallow implants in Si have been investigated. TXRF is very sensitive to the near surface part of the implant and to the total retained fluence, SIMS is the main technique for the determination of the depth profile and MEIS can add information on the crystal structure of the sample.

ABSTRACT: MN21

Luminescence of lanthanides from xerogels embedded in mesoporous matrices

N. V. Gaponenko[1], G. K. Malyarevich[1], D.A. Tsyrkunou[1], E. A. Stepanova[1], A. V. Mudryi[1], V. E. Borisenko[1], I. S. Molchan[2], P. Skeldon[2], & G. E. Thompson[2]

[1] Lab. of Nanophotonics, Belarusian State Univ. of Informatics and Radioelectronics, Browki St.6, 220013 Minsk, Belarus, email: nik@nano.bsuir.edu.by, [2] Corrosion and Protection Center, The Univ. of Manchester, United Kingdom

The report summarises peculiarities of synthesis and luminescence properties of porous anodic alumina (PAA) and artificial opals with the inclusions of sol-gel derived oxides (xerogels), doped with Er, Tb and Eu. Interest in sol-gel synthesis arises from the relatively low cost and the approach allows the chemical content and concentration ratio of the elements of the sol-gel derived films to be tailored, with ready fabrication onto different substrates and in mesoporous matrices as well. The structures xerogel/porous silicon, xerogel/(PAA) and xerogel/artificial opals were investigated over the last decade [1]. Multiple scattering of light and redistribution of the photonic density of states by PAA matrix [2] reveal enhanced photoluminescence (PL) of lanthanides from xerogel/PAA structures [3]. A method for the fabrication of luminescent images based on anodizing of aluminium, photolithography and sol-gel process is proposed.

Photoluminescence excitation spectra (PLE) for the emission wavelength 1.54 μm were compared for erbium-doped titania and titania-silica xerogels embedded in artificial opals [4] and PAA films. In comparison to the structure erbium-doped titania xerogel/PAA the PLE spectra for 1.54 μm emission wavelength significantly changes for the same xerogels embedded in artificial opals [5,6]. For the structure opal/TiO_2:Er the appearance of the strong PLE band at 360 nm has been found. Influence of chemical factor of SiO_2/TiO_2 composite and light scattering on erbium PLE is discussed.

[1] N.V. Gaponenko, *Synthetic Metals* 124, 125 (2001) 125
[2] A. A. Lutich, S.V. Gaponenko, N.V. Gaponenko et al. *Nano Lett.* 4 (2004) 1755
[3] N. V. Gaponenko, J.A. Davidson, B.Hamilton et al. *Appl. Phys. Lett.* 76 (2000) 1006.
[4] V.N.Bogomolov, S.V.Gaponenko, I.N.Germanenko et al. *Phys. Rev. E.* 55 (1997) 7619.
[5] N.V. Gaponenko, D.M. Unuchak, A.V. Mudryi et al, *Journal of Luminescence* 121 (2006) 217.
[6] N.V. Gaponenko, G.K. Malyarevich, D.A. Tsyrkunou et al, *Optical Materials* 28 (2006) 688–692.

ABSTRACT: MN4

Mechanochemistry in preparation of nanocrystalline semiconductors

P. Baláž [1], E. Dutková [1], E. Gock [2]

[1] Instit. of Geotechnics, Slovak Academy of Sciences, Watsonova 45, 043 53 Košice, Slovakia, [2] Clausthal Univ. of Technol., Instit. for Mineral Processing & Waste Disposal, German, 38678 Clausthal-Zellerfeld, Germany

In recent years nanocrystalline semiconductors (QD) have attracted much attention due to their great potential in technological applications. Electronic, optical and other properties of QD with respect to corresponding bulk materials are modified considerably, offering a number of potential applications in semiconductor and other industries.

Nanophases have been synthesized by a number of techniques starting from vapor phase (i.e. inert gas condensation), liquid phase (i.e. rapid solidification) and solid state. The technique starting from solid state applies mechanochemical approach (reactive milling) where synthesis of nanophases can be performed by solid state reactions.

We have developed the mechanochemical route to produce MeS nanocrystals applying reactive milling of metal acetates $Me(Ac)_2$ (Me=Zn, Cd, Pb) with sodium sulphide Na_2S. ZnS, CdS, PbS and other nanocrystalline semiconductors have been obtained with estimated sizes 5-10 nm (Fig. 2).

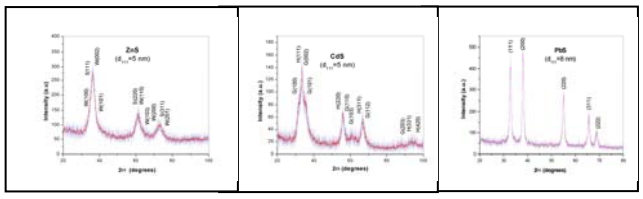


Fig. 1

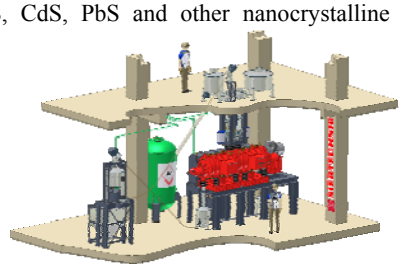


Fig. 2

The main advantage of the mechanochemical route for preparation of nanocrystalline semiconductors via reactive milling is that it is “a quantity process” permitting kilogram quantities of materials to be produced at an ambient temperature in a very short processing time (Fig 2).

SESSION 14: NANOSTRUCTURES: MATERIALS and DEVICES

ABSTRACT: MN42

Bias Dependence of Spin-Transfer Torque in Magnetic Tunnel Junctions

Ioannis Theodonis[1], Nicholas Kioussis[2], Alan Kalitsov[3], Mairbek Chshiev[4], W.H. Butler[4]

[1]Depart.of Physics, National Technical Univ.Athens, Zografou Campus 15780, Greece, email: ytheod@mail.ntua.gr, [2]Theoretische Physik, Univ.Kassel, Heinrich-Plett-Strasse 40, 34132, Germany, [3]Department of Physics, California State Univ.Northridge, CA 91330-8268, USA, [4]MINT Center, Univ.of Alabama, P. O. Box 870209, Tuscaloosa, USA

The current-induced magnetization switching (CIMS) in non-collinear magnetic tunnel junctions (MTJ)[1] through the spin-transfer torque [2] provides a powerful new tool for the study of spin transport in electronic structures. It offers the intriguing possibility of manipulating high-density nonvolatile magnetic-device elements, such as magnetoresistive random access memory (MRAM)[3], without applying cumbersome magnetic fields. A critical aspect of MTJ, which is of great practical importance, is the comprehensive understanding of the bias dependence of the spin transfer torque. Using tight-binding calculations and the non-equilibrium Keldysh formalism[4], we have studied the effect of applied bias on the components of the spin-transfer torque parallel, $T_{\parallel}$, and perpendicular, $T_{\perp}$, to the interface. We predict an anomalous bias dependence of the parallel component of the spin torque, contrary to the general consensus. First, we demonstrate that depending on the exchange splitting, $T_{\parallel}$ may exhibit an unusual and interesting non-monotonic bias dependence: it may change sign without a sign reversal in bias or current, and in some cases it may even have a quadratic bias dependence. Second, we show that $T_{\parallel}$ satisfies an expression involving the difference in spin currents between the FM and antiferromagnetic (AF) configurations. Third, the bias dependence for the spin current for the FM (AF) alignment is shown to have a linear (quadratic) bias dependence, whose origin lies on the symmetric (asymmetric) nature of the barrier. The interplay of the spin currents for the FM and AF configurations can lead to a rich behavior of the $T_{\parallel}$ on bias. Finally, we find that $T_{\perp}$, which measures the non-equilibrium exchange coupling in the MTJ, is comparable in size with $T_{\parallel}$, and exhibits a quadratic bias dependence.

References:

[1] E.B. Myers, D.C. Ralph, J.A. Kattine, R.N. Louie, R.A. Buhrman, Science 285, 867 (1999).
[2] J.C. Slonczewski, J. Magn. Magn. Mat. 159, L1 (1996).; L. Berger, Phys. Rev. B 54, 9353 (1996).
[3] M. Hosomi, H. Yamagishi, T. Yamamoto, K. Bessho, Y. Higo, K. Yamane, H. Yamada, M. Shoji, H. Hachino, C. Fukumoto, H. Nagao, H. Kano, Electron Devices Meeting, 2005. IEDM Technical Digest. IEEE Internat.Vol., Issue , Dec. 5, 2005 Page(s): 459-462.
[4] C. Caroli, R. Combescot, P. Nozieres, D. Saint-James, J. Phys. C: Solid St. Phys. 4, 916 (1971).

ABSTRACT: MN135

Study of the r-plane sapphire nitridation for epitaxial growth of a-plane GaN by molecular beam epitaxy

G. Tsiakatouras[1], J. Smalc[2], K. Tsagaraki[1], M. Androulidaki[1], Ph. Komninou[2] and A. Georgakilas[1]

[1]Microelectronics Research Group (MRG), Inst. of Electronics Structure and Laser (IESL), Foundation of Research and Technology-Hellas (FORTH), P.O. Box 1527, 71110, Heraklion Crete, Greece and Physics department, University of Crete, Heraklion Crete, Greece, [2]Department of Physics, Aristotle University of Thessaloniki, 54124 Thessaloniki, Greece, *E-mail: tsiakat@physics.uoc.gr

The last few years there has been a great interest in the growth of nonpolar III-nitride films. Non-polar heterostructures are very promising because of the lack of the quantum confined Stark effect caused by built-in piezoelectric fields. Today the growth of a-plane GaN on r-plane sapphire is still challenging and many parameters have to be investigated in order to achieve a good crystal quality. One of these parameters is the nitridation of sapphire substrate, a procedure that improves the characteristics of sapphire surface. Active nitrogen atoms modify the surface of Al_2O_3 by assisting the O to N anion exchange, converting the substrate from Al_2O_3 to AlN. In this work, the effect of the nitridation temperature on the r-plane sapphire substrate and the overgrown a-plane GaN epilayer has been investigated. R-plane sapphire substrates were nitridated for one hour at low (200ºC) and high (800ºC) temperatures. The GaN epilayer was grown under the same conditions for all samples. For the characterization of the films AFM, XRD, PL and TEM measurements were performed. XRD and TEM measurements confirmed the growth of single crystalline a-plane GaN on the r-plane sapphire. According to AFM results, the surface of low temperature nitridation is smoother than the surface of high temperature nitridation. However, XRD and TEM measurements revealed that the sample with the high temperature nitridation has better crystal quality and smaller density of threading dislocations. The sample with the high nitridation temperature exhibited high intensity luminescence compared to the sample with low nitridation temperature. These results for a-plane GaN grown on r-plane sapphire are not in agreement with the corresponding nitridation results for c-plane GaN grown on c-plane sapphire substrates.

ABSTRACT: MN31

Solid phase epitaxial re-growth and creation of nano-defects in Si:He studied by deuterium plasma treatment

ANDRZEJ MISIUK[1], ALEXANDER G. ULYASHIN[2], BARBARA SURMA[3], JADWIGA BAK-MISIUK[4], WOJCIECH JUNG[1], AND MAREK PRUJSZCZYK[1]

[1]Institute of Electron Technology, Al. Lotnikow 46, 02-668 Warsaw, Poland misiuk@ite.waw.pl
[2]Institute for Energy Technology, P.O.Box 40, NO-2027 Kjeller, Norway
[3]Institute of Electronic Materials Technology, Wolczynska 133, 01-919 Warsaw, Poland
[4]Institute of Physics, PAS, Al. Lotnikow 32/46, 02-668 Warsaw, Poland

Implantation of silicon with He^+ results in its amorphisation. At high temperatures (HT) amorphous silicon (aSi) is subjected to solid phase epitaxial re-growth (SPER); nano- dimensional defects (also He-filled bubbles [1]) are created. Processing of Si:He under enhanced hydrostatic pressure (HP) results in a creation of porous–like layers; in Si co-implanted with H^+ and He^+ (Si:H,He) such layers release hydrogen in specific way [2]. Bubbles and nano-dimensional defects are of interest for internal gettering. Such defects can accumulate hydrogen from hydrogen plasma [3]. This effect is presently applied to study SPER and nano-defects in Si:He.
To produce Si:He, B-doped Czochralski silicon was implanted with He^+ at 75 keV to a dose $2.5x10^{16}$ cm^{-2}. To produce the layer containing nano-defects, Si:He was processed at up to 920 K for up to 10 h under HP ≤ 1.1 GPa. Si:He was subsequently subjected at ≈ 500 K to the D_2^+ plasma treatment. Both before and after the treatment, Si:He was investigated by Secondary Ion Mass Spectrometry, photoluminescence, X-Ray and related methods.
Plasma treatment and resulting deuterium accumulation reveal marked effect of HP applied at 723 K and 923 K on SPER and porosity of buried disturbed layer.
For example, as-implanted Si:He and that processed for 1 h at 723 K under 10^5 Pa accumulated deuterium up to above $1x10^{20}$ cm^{-3} concentration while accumulation under 1.1 GPa was about 4 times higher. Other features of plasma treated Si:He are also strongly dependent on HP.
Our results confirm HP–mediated [1] creation of specific nano-defects / bubbles within implantation-disturbed layer in Si:He.

1. J.Bak-Misiuk, A.Shalimov, A.Misiuk, J.Härtwig, J.Trela, J. Alloys Comp. 401 (2005) 64.
2. A.Misiuk, A.Barcz, phys. stat. sol. (c) 4 (2007) 2011.
3. A.Y.Usenko, A.G.Ulyashin, Jpn. J. Appl. Phys. 41 (2002) 5021.

ABSTRACT: MN8

SOI-nanowieres as sensors of charge

O.V. Naumova, D.A. Nasimov., B.I.Fomin, N.V.Dudchenko, T.A.Gavrilova, E.V. Spesivtsev, V.P.Popov

Institute of Semiconductor Physics, SB RAS, Novosibirsk, Russia, e-mail:naumova@isp.nsc.ru

Silicon-on-insulator (SOI) wafers are precisely engineered multilayer semiconductor/dielectric structures that provide new functionality for advanced Si devices. Strips or nanowires of Si fabricated by structuring of the top silicon layer can be used as a body of the metal-oxide-semiconductor field-effect transistor (MOSFET) including of alternative designs of multiple-channel and multiple-gate transistors [1, 2], single-electron transistors with the side-gates (made in the same silicon layer as well as a body of the transistor) and so on [3, 4].
Silicon nanowires with the ohmic contacts on the ends and free surface allow their use as highly effective field-effect sensing elements [5, 6]. Charge from adsorbed particles induces compensating charge in the nanowire, modulating its conductance and, consequently, the current flowing between two electrodes. The device, acts as a sensitive field-effect transistor, with adsorbed charged species acting as the "gate". The most important feature nanowieres on the base of SOI structures is that substrate can be used as an additional gate. Therefore, SOI-nanowieres have an additional opportunity of management (change) of sensitivity of the device.
In this report we focus on the properties of ultrathin SOI, reveal some problems arisen due to fabricating of the SOI-nanowieres and present the results of conductivity of SOI-nanowieres at different surface charge.

This work was supported by the FCNTP grant No. 02.513.11.3057

[1] G.K.Celler, and S. Cristoloveanu, J. App.Phys. 93, 4955 (2003)
[2] J.T. Park, and J.P. Colinge, , IEEE Trans. Electron.Dev. 49, 222 (2002)
[3] L.Zhuang, L.Guo, and S.Y.Chou, Appl.Phys.Lett. 72,1207 (1998)
[4] A.Tilke et.al., J.Appl.Phys. 90, 942 (2001).
[5] Cui Y, Wei Q, Park H and Lieber C M Science. 293, 1289 (2001)
[6] J-I Hahm and C M Lieber, Nano Lett. 4, 51 (2004)

ABSTRACT: MN100

Calculated transport coefficients in a SET

X. Zianni

Department of Applied Sciences, Technological Educational Institution of Chalkida,
34 400 Psachna, Greece, e-mail: xzianni@teihal.gr

The transport coefficients of a quantum dot or molecule in the single electron transistor (SET) configuration have been calculated in the sequential tunneling regime. General formalism and analytical expressions have been obtained for the conductance, G, the thermopower, S, and the thermal conductance, κ. The periodicity, the fine structure, the amplitude and the shape are discussed as a function of the energy spectrum, the thermal energy and the charging energy. Coulomb Blockade oscillations are shown at low temperatures and simple formulae are obtained for G, S and κ. The effects of energy degeneracy and of an irregular energy spectrum are analysed. In the quantum regime, the obtained dependence on the energy level spacing and the thermal energy shows that quantum confinement is responsible for the fast decrease of the electron thermal conductance of a dot. However, it is shown that electron-phonon coupling can cause a considerable increase in the electron thermal conductance. This effect is studied as a function of the strength of the electron-phonon coupling, of the phonon frequency and of the temperature. The temperature dependence of G, S and κ has been calculated up to the limit where transport occurs through two isolated barriers. When electron-phonon coupling is neglected, Wiedermann-Franz law holds in the classical regime at the peaks of κ and G at low temperatures, and at all gate voltages at higher temperatures.

ABSTRACT: MN101

Controlled Population Dynamics in Semiconductor Quantum Well and Quantum Dot Structures

Emmanuel Paspalakis[1], Constantinos Simserides[1], Antonios Fountoulakis[2] & Andreas F. Terzis[2]

[1]Materials Science Department, School of Natural Sciences, University of Patras,
Patras 265 04, Greece
[2]Physics Department, School of Natural Sciences, University of Patras,
Patras 265 04, Greece

In this work we present results on the quantum control of the dynamics of semiconductor nanostructures by the application of external electromagnetic fields. In particular, we study the case of controlled population (electron) transfer in semiconductor quantum wells, including the effects of electron-electron interactions. This is a problem that has attracted intensive interest recently, as it has been shown that the inclusion of the electron-electron interactions makes the two-subband or the three-subband system to behave quite differently from non-interacting (atomic-like) two-level or three-level systems [1-4]. For the description of the system dynamics we use the proper density matrix equations, obtained from a time-dependent Hartree approach. We also present results on population transfer between the two lower states in a coupled semiconductor quantum dot structure that interacts with electromagnetic pulses [6,7]. We apply the few-level system approximation and the rotating wave approximation and present analytical conditions that should be fulfilled in order to have complete single-electron transfer. In addition, the validity of the analytical results is assessed by numerical solutions of the time-dependent Schrödinger equation.

References

[1] A. A. Batista and D. S. Citrin, Phys. Rev. Lett. 92, 127404 (2004); Phys. Rev. B 74, 195318 (2006)
[2] A. A. Batista, Phys. Rev. B 73, 075305 (2006).
[3] E. Paspalakis, M. Tsaousidou, and A. F. Terzis, Phys. Rev. B 73, 125344 (2006); J. Appl. Phys. 100, 044312 (2006).
[4] E. Paspalakis, M. Tsaousidou, and A. F. Terzis, in *Future Trends in Microelectronics: Up to the Nanocreek*, edited by S. Luryi, J. Xu and A. Zaslavsky, (Wiley - IEEE Press, 2007), p. 432.
[5] B. Galdrikian and B. Birnir, Phys. Rev. Lett. 76, 3308 (1996).
[6] S. Selsto and M. Forre, Phys. Rev. B 74, 195327 (2007).
[7] M. Forre, J.P. Hansen, V. Popsueva, and A. Dubois, Phys. Rev. B 74, 165304 (2006).

POSTER SESSION 1:

MATERIALS FABRICATION & CHARACTERIZATION

ABSTRACT: P I.1

STUDY OF POLYSTYRENE FILM COATING ON THE SURFACE OF POROUS SILICON

F-Z. TIGHILT[1,2], S. SAM[1], N.BELHANECHE[2] and N. GABOUZE[1]

[1] UDTS, 02Bd. Frantz Fanon, B.P. 140. 7 merveilles Alger – Gare, Algiers, Algeria, [2] ENP, 10, Avenue Hassen Badi- B.P. 182- 16200 El Harach, Algiers, Algeria.

The grafting of organic molecules onto semiconducting substrates modifies their surface properties and can be used to prepare materials with potential applications such as capacitors, sensors, anti-corrosive coatings, batteries and actuators.

The macromolecules with conjugated double bonds are distinguished from other types of polymers by their electronic conductivity. These properties are the basis for a growing interest over the last decades. One of the investigated material is the polystyrene (PS), because of its good environmental stability.

In this work, the polystyrene (PS) grafted onto the porous silicon by three different methods: dip coating, spin coating and spreading method has been studied. For this purpose, Fourier transform infrared spectroscopy (FTIR), scanning electron microscopy (SEM) and energy dispersive spectroscopy (EDS) have been carried out to evaluate the surface modification.

The FTIR spectra show the existence of specific interactions especially a stronger hydrogen bending which is suspected to occur between the hydroxyl groups present at the surface of the porous silicon substrate and л electrons of the polystyrene aromatic cycle. Moreover, The EDS spectrum shows the presence of a peak attributed to the carbon which is the principal constituent of the PS polymer.

In addition, SEM observations show that the morphology of the PS macromolecular chains strongly depends on the deposition- coating method.

Keywords : Porous silicon, polystyrene (PS), hydrogen bonding, surface coating.

ABSTRACT: P I.2

Degradation of NO_2-nitrided oxides under electrical field stress and irradiation

O.V.Naumova, B.I.Fomin, N.V.Sakharova, V.P.Popov

Institute of Semiconductor Physics, SB RAS, Novosibirsk, Russia, e-mail:naumova@isp.nsc.ru

Intensive efforts are being made in finding alternative high-k gate dielectrics, but the use of SiO_2 is also continue in the silicon-on-insulator (SOI) devices, nonvolatile memory and high-k/SiO_xN_y stack of dielectrics. It is well known that the oxide property are strongly depend on the processing conditions, and incorporation of nitrogen in oxides are very attractive in terms of immunity of traps generation under the current stress and radiation. Therefore, it is important to continue efforts in understanding the degradation of nitride oxide and its interface with silicon.

The evaluation of NO_2 -nitride oxides during irradiation and electrical field stress is discussed in the present report. MOSFETs or MOS capacitors with p^+- and n^+-poly-Si gates were used as testing samples.

Gate dielectrics were grown thermally in O_2 ambient at 850 ^oC. Nitridisation was carried out in NO_2 ambient at the same temperature. Posts oxidizing annealing (POA) were done in nitrogen atmosphere at 850 ^oC and 900 ^oC. Post-metallization annealing in forming gas or Ar were carried out with the aim to determine an influence of the hydrogen on the traps behavior.

Properties of the MOS dielectric layers were evaluated via current-voltage, j-Ramp and current-temperature techniques. The effect of irradiation on oxides was examined using ^{137}Cs as the gamma-ray source. The total dose was varied from $3x10^5$ to $3x10^7$ rads.

Results shown, that type, density of the as-grown and accumulated after irradiation oxide traps are strongly depend on the POA temperature and ambient of PMA. In particular it is found, that the POA at 950 ^oC (in contrast to POA at 850 ^oC) reduces density of the oxide traps by the order and eliminates the slow electron traps in oxide. The carrier transport through the oxide after breakdown is determined by two mechanisms: the Poole-Frenkel at the electrical field in oxide up to 3 MV/cm and trap-assisted tunneling after that. The emission trap energy value is about E_c~0.63 eV for irradiated and ~1.1 eV for non-irradiated MOS-structures.

ABSTRACT: P I.3

Covalent and Non-Covalent Functionalization of Carbon Nanotubes and Carbon Nanohorns with Polymers

Grigoris Mountrichas,* Stergios Pispas & Nikos Tagmatarchis

Theoretical and Physical Chemistry Institute, National Hellenic Research Foundation, 48 Vass. Constantinou Ave., 11635 Athens, Greece, e-mail: gmountri@eie.gr

Carbon nanostructures, like the well known carbon nanotubes (CNTs) and the newly discovered carbon nanohorns (CNHs), are promising materials towards a wide gamut of applications in biomedicine, nanoelectronics, and materials science. The inherent insolubility of both CNTs and CNHs hampers their utilization in nanotechnological applications. On going efforts of our group concern the solubility enhancement of these materials which will aid not only the study of their solution properties but most importantly the preparation of a series of novel nanosized hybrids. Towards this end, CNTs and CNHs have been functionalized with polymers by applying diverse strategies. In this context, we have succeeded in the covalent attachment, as well as non-covalent wrapping of polymers onto the skeleton of the carbon-based nanostructures (Scheme 1). Importantly, with the latter approach the novel π-electronic network of CNTs and CNHs remain intact, however, the interactions between the polymers and the carbon nanostructures are strong enough that solubilization of the nanosized hybrid material is achieved. Moreover, we have been able to combine functionalities of the polymer with the exotic properties of the carbon-based materials. The hybrid materials were characterized by a variety of complementary analytical techniques, investigated morphologically by state-of-the-art HR-TEM and DLS, while their photophysical properties were exploited towards applications in energy conversion schemes.

ABSTRACT: P I.4

Liquid and gaseous stain etching of micro-machined silicon structures

V. Melnikov[1], V. Yu. Timoshenko[2], E. Astrova[3], T. Perova[1], V. Srigengan[4], H. Gamble[4]

[1] Department of Electronic and Electrical Engineering, Trinity College, Dublin 2, Ireland, [2] Moscow State M.V. Lomonosov University, Physics Department, Moscow, Russia, 119992, [3] Ioffe Physico-Technical Institute, Polytechnicheskaya 26, St.-Petersburg, Russia, 194021, [4] School of Electrical & Electronic Engineering, Queen's University of Belfast, Ashby Building, Stranmillis Rd, Belfast, BT9 5AH. UK

Liquid and gas stain etching has been successfully applied for nanostructuring of grooved silicon structures which can be considered as reactor prototype for bio and chemical reactions. Grooved silicon structures with different periods produced by deep reactive ion etching and anisotropic alkaline etching have been treated by stain etching in $HF+NaNO_2$ solutions. Porous layer thickness and nanocrystals distribution have been investigated by micro photoluminescence (PL) measurements. It has been found that different parts of the structures are stain-etched differentially: the upper area of the groove sidewalls and their upper surface are etched with the highest etch rate and possess the most intense PL. The lower part of the sidewalls has the minimal porous film thickness and the weakest PL, while the light emission from the bottom of the grooves is higher. The rugged surfaces demonstrate higher PL intensity than the smooth surfaces. Many factors determine the etch rate of various parts of the structure. Stain etching is sensitive to the surface morphology and to the difference in the surface potential of various parts of the silicon structure in solution and exhibits selectivity of the etching rate. In our experiments the favourable formation of uniform porous layer was observed for grooved silicon structures fabricated by deep reactive ion etching. Nanostructuring of microstructures adds new degree of freedom for their further functionalization and utilizing for bio and chemical applications.

ABSTRACT: P I.5

Nutritional applications of nanostructured silicon: an edible semiconductor

Leigh Canham

pSiNutria Ltd, Malvern Hills Science Park, Geraldine Rd, Malvern, Worcestershire, WR14 3SZ, UK

Silicon is the second most abundant element in our environment , and after iron and zinc, the third most abundant trace mineral in our bodies. There is increasing interest in whether optimum levels of orthosilicic acid in blood can play a role in bone health, and in particular, can assist calcium supplements in the prevention of osteoporosis. I will describe routes to nanostructuring inexpensive silicon powder, commercially available at the metric ton level, in order to improve silicon bioavailability in the human gut. Experiments have also shown that nanoscale silicon is remarkably stable in a range of beverages and foods, so mesoporous microparticles can be used as a carrier system for established nutrients such as vitamins or fish oils (1). This is an extension of recent pharmaceutical R&D that has shown the merits of nanostructuring hydrophobic drugs (2).

(1) L.T.Canham. Nanotechnology 18,185704 (2007)
(2) C.Prestidge et al. Expert Opinion Drug Delivery 4,101 (2007)

ABSTRACT: P I.6

FeNi alloys electroplated into porous (n-type) silicon

S.Ouir[1,2], S.Sam[1],G.Fortas[1], N.Gabouze[1], A. Manseri[1], K. Beldjilali[1]

1. UDTS, 02, Bd. Frantz Fanon, B.P. 399 Alger-Gare, Algiers, Algeria
2. USDB, B.P. 270, route de Soumaa, Blida, Algeria

FeNi alloys have a variety of high technology applications (such as magnetic storage devices and sensors) due to their wide spectrum of physical properties. A simple and inexpensive production technique of magnetic thin films is electrodeposition. It has been used successfully in the case of FeNi alloys for a wide range of concentrations of both elements.
We report here the study about the electrodeposition of FeNi alloys into porous silicon (PS) made in n-type Si (1-10 Ωcm).
The electrodeposited thin films were characterized by scanning electron microscopy (SEM), energy dispersive spectroscopy (EDS), X-ray diffraction (XRD) and secondary ion mass spectrometry (SIMS).
The results show that the morphology, composition and structure of the deposited FeNi alloys are strongly dependent on the deposition conditions. A tubular structure of the FeNi alloys has been obtained with a chemical composition of (80%) Ni (20%) Fe.
Finally, SEM and SIMS characterization show that the FeNi alloy deeply penetrates into PS.

ABSTRACT: P I.7

Correlation between Transport, Dielectric and Optical Properties of Porous Silicon

Amir Sa'ar

Racah Institute of Physics and the Center for Nanoscience and Nanotechnology, the Hebrew University of Jerusalem, Jerusalem 91904, Israel

In this presentation, I will review our recent progress in developing a comprehensive picture of the various transport phenomena and their correlation with the optical properties of porous silicon. We have found that there are two major transport routes in porous silicon. The first route of conduction via the host disordered tissue that surrounds the silicon nanocrystals dominates for non-oxidized porous silicon and gradually disappears during a first stage of oxidation where the host tissue of amorphous silicon compounds is oxidized. The second route of tunneling and hopping in between the nanocrystals persists up to a second stage of oxidation where the nanocrystals are oxidized. This dual transport channel picture explains the presence of two ac-and dc-conductivities in porous silicon and the gradual disappearance of those processes associated with conduction in the disordered tissue with oxidation. In addition, we have found that geometrical constrictions along the transport path are responsible to the large activation energy associated with dc-conduction.

ABSTRACT: P I.8

THE ROLE OF H_2O MOLECULES IN THE PROCESS OF AMMONIA ADSORPTION ON THE SILICON NANOSTRUCTURES SURFACE

ALEXANDER V. PAVLIKOV, IVAN B. LEUKHIN, ANTON A. SILAEV, ALEXANDER S. VORONTSOV and VICTOR YU.TIMOSHENKO

Faculty of Physics, Moscow State University, Leninskie Gory, 119992 Moscow, Russia; e-mail: pavlikov@vega.phys.msu.ru

Porous silicon (*por*-Si) is formed from c-Si by electrochemical etching in hydrofluoric acid solutions. It appears that at a reasonably high porosity (>50%), this material consists of a system of coupled silicon nanocrystals. Thus, the *por*- Si specific surface can be as large as $\sim 10^3$ m^2/g and the internal space is open for the environmental molecules. Owing to these peculiarities the adsorption of the surrounding medium has a significant effect on the electronic properties of nanocrystals.

The present work is focused on the study of the role of H_2O molecules in the process of ammonia adsorption in porous-silicon layers with various initial types and concentrations of dopants by means of FTIR spectroscopy. It is found that adsorption of dry ammonia does not result in a noticeable increase of free electrons concentration in *n*-type samples, while the adsorption of ammonia from water solution brings to an increase of free electrons concentration up to a level exceeding $10^{18} cm^{-3}$. In *p*-type samples the adsorption of dry ammonia results in a decrease of free holes, but does not lead to inversion of the conductivity type. At the same time the adsorption from water solution reveals a nonmonotonic dependence of the charge-carrier concentration on ammonia pressure in *p*-type samples.

The obtained results are explained by the appearance of adsorption-induced shallow donor states that, along with the initial-dopant and surface-defect states, determine the charge-carrier type and concentration in the silicon nanocrystals of the porous layer after ammonia adsorption. The observed significant changes of the electronic properties of silicon nanocrystals are promising in view of new sensor applications.

ABSTRACT: P I.9

Durability and photophysical properties of surfactant-covered porous silicon particles in aqueous suspensions

María Balaguer,[1)] Ester Pastor,[1)] Leszek Bychto,[1,2)] Pedro Atienzar,[3)]
Miguel A. Miranda,[3)] Vladimir Chirvony,[1)] Eugenia Matveeva[1)]

[1)]Nanophotonics Technology Center, Universidad Politécnica de Valencia, Cami de Vera s/n 46022 Valencia, Spain, [2)]Department of Electronics and Computer Sciences Koszalin University of Technology, Śniadeckich 2, 75-453 Koszalin, Poland, [3)]Instituto de Tecnología Química CSIC-UPV, Universidad Politécnica de Valencia, Av. de los Naranjos s/n, 46022 Valencia, Spain

Luminescent silicon nanocrystals can effectively interact with molecular oxygen and generate singlet oxygen, $^1O_2$, in a gas phase [1] and thus this material is promising for photosensitizing applications. However, in order to take advantages of these new properties in biomedical purposes (for instance in a photodynamic therapy [2]]) the as-prepared H-terminated (i.e. hydrophobic) luminescent porous silicon (PSi) must be first made miscible with biological (aqueous) liquids. Moreover, necessary surface modifications of PSi should be performed without any considerable quenching of luminescence and on a material suitable for medical administration (i.e. in form of a fine powder).

In the present work two different surface treatments were applied to the same PSi material prepared electrochemically and then milled into the fine powder. The first type of treatment was a chemical binding of undecylenic acid to the PSi surface (thermal procedure) and the second was a physical adsorption of the same substance as a simple surfactant (room temperature procedure) [3]. Then we compared how both these treatments influence luminescence properties and durability of aqueous suspensions of the modified materials and how an interaction between PSi excitons and O_2 molecules in watery solutions is developed. Behaviour of PSi suspensions in de-ionized water and physiological electrolyte Simulated Body Fluid (SBF) was studied and compared.

We found that both types of coverage are suitable not only for making PSi hydrophylic but also for protection of its optical activity. In the case of chemically modified PSi luminescence of the powder suspension is preserved at high intensity level during sufficiently long time: for more than 30 days in de-ionized water and for several days in SBF. In the case of physically modified PSi luminescence of the powder suspension is sufficiently stable only in de-ionized water (at least 10 days) but not in SBF (a few hours). On the other hand, an ability of the PSi excitons to be quenched by O_2 in aqueous suspensions is found to be sufficiently high only for physically covered PSi. We discuss the possible chemical processes on PSi surface in watery ambient throughout the storage time and their influence on physical interaction with dissolved oxygen.

1. D. Kovalev, M. Fujii, Adv. Mater. 2005, 17, 2531.
2. T.J. Dogherty, Photochem. Photobiol. 1987, 45, 879.
3. V. Chirvony, A. Chyrvonaya, J. Ovejero, E. Matveeva, B Goller, D, Kovalev, A. Huygens, P. de Witte, Adv. Mater. 2007, 19, in press.

ABSTRACT: P I.10

Monitor the properties of silicon nanocrystals embedded in SiO_2 matrix using ultrashort laser pulses

Emmanouil Lioudakis[1,*], Andreas Othonos[1], Alexandros Emporas[1] and A. G. Nassiopoulou[2]

[1] Research Center of Ultrafast Science, Depart. of Physics, Univ. of Cyprus, P.O. Box 20537, 1678, Nicosia, Cyprus
[2] IMEL/NCSR Demokritos, P.O. Box 60228, 15310, Aghia Paraskevi, Athens, Greece
*mlioud@ucy.ac.cy

In this work, we report on ultrafast carrier dynamics study of silicon nanocrystals (SiNCs) embedded in silicon dioxide matrix. Our samples were fabricated using low pressure chemical vapour deposition technique and the size of formed NCs was confirmed by transmission electron microscopy measurements. We present degenerated and non-degenerated time-resolved measurements giving an important insight of the coupling between quantized and surface states surrounding the NCs due to the oxygen passivation. In view of this analysis, we have determined for the first time the energy of lower unoccupied molecular orbit for 4 and 2.5 nm nanocrystals as well as the observable relaxation dynamics. Furthermore, the influence of the quantum confinement effect and the reported pinning of the gap on the optical properties is presented in detail.

ABSTRACT: P I.11

On the limits of a classical theory of crystalline defects: An application to type III-N nitrides

Amina Belkadi[1], Toby D. Young[1] , Pawel Dluzewski[1] , Jun Chen[2] , P. Lei Huaping[3] & Gerard Nouet[3]

[1]Institute of Fundaqmental Technological Research, Polish Academy of Sciences, ul. Swietokrzyska 21, 00-049, Warsaw, Poland, [2]LRPMN Université de Caen, IUT Alençon, 61250, Damigny, France, [3] SIFCOM, UMR6176, CNRS-ENSICAEN, 6 BLD. Marechal juin, Caen 14050, France

Crystalline defects in type III-N semiconductor materials are well investigated due to their affect on materials in terms of their structural, electronic and optical response.The emergent physical features of dislocations on large practical devices can be effectively investigated on the classical and the semi-classical scale by employing continuum mechanics. One well-known problem in continuum theory is the demand for taking into account the dislocation core where poles appear in the deformation and strain energy. The first requirement therefore in deriving a micro-macro theory of dislocation phenomena is to provide a sufficient mathematical representation of the dislocation core.

In this work we present a formalism based on the theory of elasticity to represent edge-dislocations for conducting further investigations using continuum mechanical modeling on the micro-macro scale. Our formalism takes into account the core by introducing a subspace representation of the classical equations of elasticity by introducing a supplementary polynomial function of second order in regions infected with singularities. The conditions for introducing the second function are taken from theoretical argument and experimental observations of the Burgers vector.

We investigate the surface topology of our representation of a single edge-dislocation and scrutinize the applicability of our formalism for applications in continuum mechanics. As an application we use our formalism as a unifying principle between continuum and discrete mechanics by introducing an edge dislocation in an atomic model embedded in continuous fields of distortion and allow the system to relax governed by the physical laws of elasticity. Our continuum approach is referred back to, and found to be in good agreement with, discrete molecular statics. The main advantages of our formalism are shown to be useful in modern continuum mechanical simulations of dislocations in heterostructures on the micro-macro energy scale for semiconducting materials.

ABSTRACT: P I.12

Analysis of TEM diffraction contrast of (In,Ga)N/GaN nanostructures

P. Manolaki, I. Häusler, A. Mogilatenko, H. Kirmse, W. Neumann

Humboldt-Universität zu Berlin, Institut für Physik, AG Kristallographie,
Newtonstrasse 15, D-12489 Berlin, Germany, e-mail: panmanol@physik.hu-berlin.de

III-Nitride semiconductor nanostructures are subject of intense studies with respect to their optoelectronic, structural and chemical properties. Important parameters for the wavelength of the emitted light are the chemical composition and the dimensionality of the nanostructures. Transmission electron microscopy can be used to determine these characteristics at a nanometer scale.

In this work, the information provided by diffraction contrast images of (In,Ga)N/GaN multi-quantum wells is studied. Experimental dark-field images alternatively using the 0001, 0002 and the 0004 reflections show a different contrast behaviour for (In,Ga)N which has wurtzite structure. This behaviour is similar to that of sphalerite materials like (In,Ga)As where a chemically sensitive 002 and a strain-sensitive 004 reflection exist.

In order to understand the different contrast regimes in case of wurtzite materials, one has to calculate the amplitude A_g of the different diffracted beams g by means of kinematical theory. The result is that the 0001 reflection is forbidden ($A_{0001} = 0$). A_{0002} is a function of the sum of the atomic scattering amplitudes of the group III and the group V element. A_{0004} depends on their difference. Consequently, the 0004 reflection is considered to be predominantly a composition sensitive one whereas the 0002 reflection is a strain-sensitive one.

For taking dynamical effects into account, amplitudes of the 0001, 0002 and 0004 beam calculated by Howie-Whelan equation will be presented. The composition x of $In_xGa_{1-x}N$ and the thickness will be chosen as parameters.

ABSTRACT: P I.13

Influence of ultra-violet radiation on properties of nanostructured silicon

S.P. Kulyk[1], M.M. Melnichenko[1] & K.V. Svezhentsova[2]

[1]Taras Shevchenko Kiev National University, Ukraine, [2]Institute of Semiconductor Physics of NASU, Ukraine, realcrystallab@univ.kiev.ua

Last years development of nanotechnologies stimulated interest in studying of nanostructured materials, which is a result of their unique physical and chemical properties. During formation of nanostructured silicon on substrates of single-crystal silicon there is a change not only in structural properties which leads to change of width of the forbidden zone and occurrence of quantum-dimension effects, but also in formation on a surface of the substrate of new connections of silicon with increased percentage of hydrogen and amorphous silicon. Such complex structure leads to occurrence of new electrophysical, photo-electric, heat-physical, electro - and photoluminescent properties.

In this work the morphology of a surface of nanostructured silicon by the method of scanning tunnel microscopy has been studied. Thickness of a layer of nanostructured silicon was defined by means of Auger electronic spectroscopy and was changing from 3nm up to 60nm depending on parameters of technological process of chemical modification of a surface of single-crystal silicon. Spectrum of photoluminescence is studied. And dependence of intensity of photoluminescence of nanostructured silicon depending on time of a ultra-violet radiation is established. Research of local density of conditions in the layers of nanostructured silicon depending on ultra-violet radiation of investigated layers by a method of scanning tunnel spectroscopy on air has been carried out.

For the first time it was shown, that ultra-violet radiation of a nanostructured layer of silicon leads to essential changes in the spectrum of electronic conditions.

ABSTRACT: P I.14

Stabilized in Organic Media Hybrid Materials Based on Complexes of Well-Defined Functional Block Copolymers with Palladium(II) acetate

Maria Demetriou and Theodora Krasia-Christoforou*

Department of Mechanical and Manufacturing Engineering, University of Cyprus,
P.O. Box 20537, 1678, Nicosia, Cyprus, *krasia@ucy.ac.cy

Over the past three decades macromolecular science seems to be strongly oriented towards the field of organic-inorganic hybrid materials. The combination of polymers with metal compounds can lead to the formation of nanometer-scale structured materials with unique properties.

Herein we report the preparation of stabilized in organic media hybrid micelles generated *via* complex formation between $Pd(CH_3COO)_2$ and well-defined diblock copolymers consisting of lauryl methacrylate (LauMA), a high alkyl-chain monomer, and 2-(acetoacetoxy)ethyl methacrylate (AEMA) a monomer possesing a metal-binding functionality. RAFT controlled radical polymerization was employed for the preparation of the block copolymers which were characterized in terms of molecular weights and compositions by size exclusion chromatography and proton nuclear magnetic resonance spectroscopy respectively.

The micellization behavior of the LauMA-*b*-AEMA was investigated in *n*-hexane, a selective solvent for the LauMA block, employing dynamic light scattering. LauMA-*b*-AEMA formed spherical micelles in dilute *n*-hexane solutions with hydrodynamic radii ranging between 30 and 50 nm. Those micelles, consisting of a hydrophobic (LauMA) corona and a ligating (AEMA) core served as an ideal nano-environment for the complexation and solubilization of $Pd(CH_3COO)_2$, which is otherwise insoluble in *n*-hexane. This was accomplished by simply mixing a micellar solution of LauMA-*b*-AEMA in *n*-hexane with the transition metal salt at room temperature. Upon metalation of the micelles, transparent yellow-coloured solutions were obtained, indicating the formation of polymer-metal complexes which was also demonstrated by UV-*Vis* spectroscopy. Dynamic light scattering and atomic force microscopy were employed for determining the size and morphological characteristics of the resulting organic-inorganic hybrid micelles.

ABSTRACT: P I.15

Magnesium incorporation at InN (0001) and (000-1) surfaces: A first-principles study

A. Belabbes, J. Kioseoglou, G. P. Dimitrakopulos, Ph. Komninou*, and Th. Karakostas

Depart. of Physics, Aristotle Univ. of Thessaloniki, GR-54124 Thessaloniki, Greece, *email: komnhnoy@auth.gr

We present first principles calculations of Mg incorporation at InN (0001) and InN (000-1) surfaces under various Mg coverage conditions obtained within the framework of density functional theory by using plane wave pseudopotential techniques. We find significant differences in Mg incorporation between In- and N-polar surfaces; Mg incorporation is easier at the In-polar surface than the N-polar one. For In-polarity high Mg coverage are found to cause important distortions while Mg atoms are substituting In atoms below the surface.
For N-polar surface the metal In-coverage on top of the N terminating layer is favored not only for In-rich conditions but also due to the tendency of N-polar InN to form In droplets on the top surface. At the N-polar surface with a full monolayer of In atoms directly above the N atoms, the preferred configurations at all coverages are those with all Mg atoms just below the In adlayer. Consequently, the In adlayer seems to promote the incorporation of Mg to the N-polar surface region.

Acknowledgements: This work was supported by the EU under the contract MRTN-CT-2004-005583 (PARSEM).

ABSTRACT: P I.16

Pulse electrochemical method for porosification of silicon and preparation of porSi dust with narrow particles size distribution

Leszek Bychto,[1,2] Yuri Makushok,[1] Vladimir Chirvony,[1] and Eugenia Matveeva[1]

[1]Nanophotonics Technology Center, Univ. Politécnica de Valencia, Cami de Vera s/n 46022 Valencia, Spain, [2]Depart. of Electronics & Computer Sciences Koszalin Univ. of Technology, Śniadeckich 2, 75-453 Koszalin, Poland

Porous silicon in form of a thin film on the surface of Si wafer or a free standing powder is a promising material with a wide variety of emerging biomedical applications ranging from drug delivery to bio-sensors [1]. Two methods for porSi preparation - an electrochemical anodization of Si wafers in HF containing electrolytes and stain etching of Si (powder) employing a chemical equivalent of the anodic oxidative process - are used for different purposes. First is used for preparation of high quality films, whereas the second is more suitable for formation of a porosified powder.
In case of anodization process morphology of the obtained porous films and their other properties could be easily modified by varying electrochemical conditions during oxidation so that porosity and pore size can be finely tuned in the framework of the electrochemical method [2, 3]. Further lift-up of the layer and its dissection into small particles by ball-milling or using ultra sonication allows a preparation of a powder with known pore parameters. The big inconvenience of the whole method is an uncertain size of the single porosified particles after milling procedure. For many purposes not only a defined pore size but also dimension of each grain of powder is of great interest.
In case of stain etching the applied chemical procedure is not well controlled and many difficulties still exist concerning reproducibility of the process. Although pore size seems to be controlled by composition of the electrolyte, the etching through of the whole volume of Si particles is questionable [4]. Since Si powder porosification in stain etching is very inhomogeneous and is applied only to the thin upper layer, quite voluminous metallic core is often left in the porosified material.
We have proposed to use a special electrochemical regime to introduce a preferable grain size into the entirely porosified Si material. This preferable grain size is “hidden” in the grown porSi film and is revealed only under additional mechanical treatment like milling. The pore dimension and total porosity are controlled by applied current density at the working pulse and prefabricated (hidden) grain size is introduced during an application of the relaxation or/and cut pulses. The overall periodic pulse electrochemical regime permits layering of the entire porosified film and defines its preferable partition in the post anodization mechanical treatment.
We have applied a described procedure to produce a sub-micrometric grain porSi powder and report preliminary results on SEM analysis of the material fabricated in different pulse regimes.

[1] M.P. Stewart, J.M. Buriak, Chemical and biological applications of porous silicon technology, *Adv. Mat.,* 2000, 12, 12, 859-869.
[2] Z. Ch. Feng, R. Tsu, Eds., Porous silicon, World Scientific Publishing Corp, 1994, pp.465
[3] V. Lehmann, Electrochemistry of Silicon. Instrumentation, Science, Materials and Applications, Wiley-VCH, 2002, pp.271
[4] D.Mills, M.Nahidi, K.W. Kolasinski, Stain etching of silicon pillars and macropores, *Phys. Stat. Sol.(a)*, 2005, 202, 8 1422-1426

ABSTRACT: P I.17

Analysis and defect characterization of III-nitride nanowires grown by Ni promoted MBE

L. Lari [1], R. T. Murray [1], M. Gass [2], T. J. Bullough [1], P. R. Chalker [1], J. Kioseoglou [3], G. P. Dimitrakopulos [3], Th. Kehagias [3], Ph. Komninou [3], Th. Karakostas [3]
C Chèze [4], L Geelhaar [4] and H Riechert [4]

[1] Department of Engineering, University of Liverpool, Liverpool, L69 3GH, UK
[2] SuperSTEM Laboratory, STFC Daresbury, Daresbury, WA4 4AD, UK
[3] Physics Department, Aristotle University, 541 24 Thessaloniki, Greece
[4] Qimonda, 81730 Munich, and NaMLab, 01099 Dresden, Germany

We report on transmission electron microscopy (TEM) and scanning transmission electron microscopy (STEM) observations of nanowires (NW) samples with compositions of uniform GaN and AlGaN with nominally 10% Al atomic weight. The NWs were grown by radio frequency plasma assisted Molecular Beam Epitaxy (rfMBE) on c-sapphire substrate. Conventional TEM images of individual nanowires, removed from the original sapphire substrate, show NWs bodies with a high density of basal stacking faults. Further analyses were performed using the aberration-corrected STEM at the SuperSTEM Daresbury Laboratory in Warrington UK. Geometric phase analysis (GPA) was applied on these data revealing the characteristic relative displacement introduced by intrinsic basal stacking faults [1]. Such defects are known to be not detrimental for the luminescence properties of GaN because they are not introducing localized stated in the band gap [2]. Imaging of the structures at the top of nanowires, i.e. of the nickel-based seeds that are employed to promote the NW-type growth, has been made, and different types of analyses were applied; in particular GPA, projection method analysis and direct measurements from FFT of the HREM images were used with good agreement between them. The measured values in the GaN nanowire body were in good agreement with the lattice constants of relaxed bulk GaN [3]. For the seed particles the resulting lattice spacing was attributable, within the experimental error, either to NiO, $GaNi_3$, or an intermediate alloy phase. Finally GPA was applied on the NW-seed interface showing a high density of misfit dislocations and the strain relief obtained by the misfit dislocation array was calculated. The results are critically discussed in relevance to the possible growth mechanisms of the NWs.

[1] J. Kioseoglou, G. P. Dimitrakopulos, Ph. Komninou, Th. Karakostas, Phys. Rev. B 70, 035309 (2004).
[2] C. Stampf and C. G. Van de Walle, Phys. Rev. B 57, 15052 (1998).
[3] "The United Kingdom Chemical Database Service", A. F. Wright, J. S. Nelson, Phys. Rev. B 51, 7866 (1995).

ABSTRACT: P I.18

Hot-wire CVD of Copper films on Self-Assembled-Monolayers of MPTMS

G. Papadimitropoulos and D. Davazoglou

NCSR "Demokritos", Institute of Microelectronics, POB 60228, 15310 Agia Paraskevi, Attiki, Greece, e-mail: gpapad@imel.demokritos.gr

Self-assembled monolayers (SAM's) of (3-Mercaptopropyl)trimethoxysilane (MPTMS) were grown on Si (100) wafers covered either with low-temperature silicon oxide (LTO) or with SiLK®. Cu films were subsequently chemically vapor deposited (CVD) on the SAM's with a novel reactor equipped with a tungsten hot-wire enabling the separate heating of the gas phase (hot-wire CVD, HWCVD). Copper films were deposited by CupraSelect® vapors, which is the commercial name of hexafluoroacetylacetonate Cu(I) trimethylvinylsilane, delivered in the reactor with the aid of a direct-liquid injection system using ultra-pure N_2 as carrier gas. High quality Cu films were deposited on SiO_2 and SiLK. Independent of the nature of the substrate, resistivities of HWCVD Cu films were found to be slightly higher than those of thermally grown films. This is due to the possible presence of impurities into the Cu films from the incomplete dissociation of the precursor and W impurities caused by the presence of the filament, which does not, however, degrade catastrophically the conductivity of Cu HWCVD films. The separate heating of the gas phase by the hot wire induced an increase of the deposition rate, which depends on the filament temperature and at 170 ^{o}C it increases by a factor of approximately one and a half.

ABSTRACT: P I.19

Molecular beam epitaxy of InN directly on Si(111) substrates

*A. O. Ajagunna, A. Vajreyi, E. Iliopoulos, K. Tsagaraki, M Androulidaki, and A. Georgakilas

Microelectronics Research Group, Physics Department, University of Crete, P. O. Box 2208, 71003 Heraklion-Crete, Greece; and Institute of Electronic Structure and Lasers, Foundation for Research and Technology-Hellas, P. O. Box 1527, 71110 Heraklion-Crete, Greece, *E-mail: debo@physics.uoc.gr

In this work, hexagonal (0001) InN films and nanowires have been grown directly on Si(111) substrates by nitrogen radio frequency plasma source molecular beam epitaxy (RF-MBE) without use of intermediate GaN or AlN buffer layer. The growth of the compact film and nanowire structures were investigated as a function of the In/N flux ratio and were characterised by XRD, SEM, Raman Spectroscopy and Hall-effect measurements. Typical values of the electron concentration and Hall mobility of the compact films were around 3 x $10^{19}cm^{-3}$ and 900 cm^2/Vs, respectively. These values are reasonably good as compared with values reported for InN grown on $GaN/Al_2O_3(0001)$ templates. Both XRD and Raman Spectroscopy revealed that the compact films were fully relaxed. The nanowires were also found to be strain-free according to Raman spectroscopy measurements. SEM micrographs revealed that the average length of nanopillars was 600nm while the diameter was found to be 60-80nm. XRD results suggest that both the compact films and the nanopillars are single crystalline. These results are very promising for the development of device quality InN and $In_xGa_{1-x}N$ structures on Si substrates for potential application in the development of high efficiency tandem solar cells. Direct growth of InN on Si(111) also provides a high flexibility to engineer nanowire structures for novel applications in the future.

ABSTRACT: P I.20

Influence of the different initiation procedures and substrate's miscut angle on the properties of epitaxial GaN-on-Si (111)

A. Adikimenakis[1*], J. Domagala[2], K. Tsagaraki[1], Ph. Komninou[3], G.P. Dimitrakopulos[3] and A. Georgakilas[1]

[1]Microelectronics Research Group (MRG), Institute of Electronic Structure and Laser (IESL), Foundation for Research and Technology-Hellas (FORTH), P.O. Box 1527, 71110 Heraklion Crete, Greece; and Physics department, University of Crete, Heraklion Crete, Greece, [2]Institute of Physics, Polish Academy of Science, Al. Lotników 32/46, 02-668 Warsaw, Poland, [3]Physics Department, Aristotle University of Thessaloniki, 54124 Thessaloniki, Greece, *E-mail: adam@physics.uoc.gr

Growth of GaN on Si (111) is particularly difficult due to a number of issues arising from the large lattice mismatch between the substrate and the grown layers and the large difference in the thermal expansion coefficients between GaN and Si. An AlN seed layer needs to be grown on Si (111) before the growth of GaN. In the present work we have investigated the role of the different initial deposition procedures on the preparation of the Si (111) surface before the growth of the AlN seed layer. Initial deposition of 1-4 ML of Al at high (700 ^oC) and low (100 ^oC) temperatures, exposure to 1-4 ML of active nitrogen flux, both at high and low temperature, and exposure to 15 min N_2 at high temperature were tested. Moreover, Si (111) substrates with different miscut angles and micut directions were tested. The GaN crystals grown were analyzed by AFM, TEM and HR-XRD. The results suggest that slight misorientation of the (111) Si surface by 1° may facilitate GaN growth by increasing the density of surface steps. Initiation of growth with 2 ML of Al at high temperature leads to GaN crystal with the lowest overall dislocation density (N_{screw}=2.3X10^7 cm^{-2}, N_{edge}= 8.4X10^9 cm^{-2}). Good results are also obtained for in-situ initial exposure of the clean Si surface to N_2 flow for 15 min. In all other cases the dislocation density is increased. XRD analysis concluded that the intermediate AlN layer used for thermal strain compensation is completely strained to the thick GaN layer, while the AlN seed layer is partially relaxed. TEM observations revealed, in addition to misfit and threading dislocations, inversion domain boundaries, stacking faults, pinholes and V-defects as the principal defect types pertinent to these samples.

ABSTRACT: P I.21

Structural and electrical characterization of phosphorus implanted germanium

P. Tsouroutas[1], D. Tsoukalas[1,2] , A. Florakis[1], I. Zergioti[1], N.Cherkashin[2], A. Claverie[2]

1 Department of Applied Physics, School of Applied Sciences, National Technical University of Athens, 15780 Zographou, Greece (e-mail: pantsr@central.ntua.gr)
2 CEMES/CNRS, 29 rue J. Marvig, 31055 Toulouse cedex 4, France

In this work we investigate the influence of pulsed ns Nd-YAG laser and conventional annealing on phosphorus diffusion and activation in germanium. Chemical and electrical dopant profiles were obtained by SIMS and Spreading Resistance Measurements respectively. Sheet resistance was estimated by Van der Pauw method and the mobility of the carriers was calculated by Hall measurements. These measurements demonstrated a box-shaped dopant profile for both conventional and laser annealed samples which are in agreement with other research reports. Box-shape of the profile is due to enhanced dopant diffusivity at high concentration for conventional annealing and to Ge substrate melting for laser annealing. Electrical characterization shows high level of activation for the dopants. On the other hand we report limited dopant loss during the laser annealing compared with ours and also similar experiments from other researchers performed with conventional annealing (RTP or furnace).
Germanium structural defects were monitored by TEM measurements and the roughness of the surface was measured by AFM. From these experiments we conclude that dopant loss during any thermal treatment is related with implantation defects in germanium. It is also demonstrated the efficiency of laser annealing in recrystallizing the amorphized Ge following P implantation at much lower energy laser fluency compared to Si and without substantial dopant diffusion and full defect removal. Additionally we also show lateral recrystallization in the vicinity of the laser spot due to high thermal distribution indicating that with adequate engineering of laser energy and spots of incidence of the laser beam one could recrystallize a complete chip area without directly irradiating the chip with the laser beam.

ABSTRACT: P I.22

Surface functionalization of 3D structures using biomolecules

A. Mourka[1,2] , V. Dinca [1,3], E. Kasotakis[4], J. Catherine[1], A. Mitraki[4], M. Farsari[1]*, and C. Fotakis[1,2]

[1]Institute of Electronic Structure and Laser (I.E.S.L.), Foundation for Research and Technology-Hellas (FO.R.T.H.), Vassilika Vouton, GR-711 10 Heraklion, Crete, Greece, [2]Department of Physics, University of Crete, Greece, [3]National Institute for Lasers, Plasma and Radiation Physics, Romania, [4] Department of Materials Science and Technology, University of Crete, Greece, mfarsari@iesl.forth.gr

Bio-micro-array fabrication and patterning of biological molecules has been the focus of much research in recent years, as they are envisaged to play an important part in genomic studies, drug discovery and screening, protein identification and scaffolding development for tissue engineering. However, there are still several issues remaining regarding biomolecules malfunction in harsh environments, as these materials are chemically and structurally very complex and heterogeneous and they easily lose their structure and biochemical activity due to dehydration or oxidation. To this end, a number of different approaches have been examined for fabricating patterned biological surfaces.
Almost in all cases, patterning of biomolecules has been two-dimensional. We demonstrate 3D patterning of biomolecules using techniques which enable the construction of arbitrary three dimensional shapes, not restricted to array-based shapes. The 3D printing, micro-structures are made employing multi-photon polymerization and their surface is subsequently functionalized with proteins and peptides. The specificity of the binding and the maintaining activity and structure of the transferred biomolecules is demonstrated.

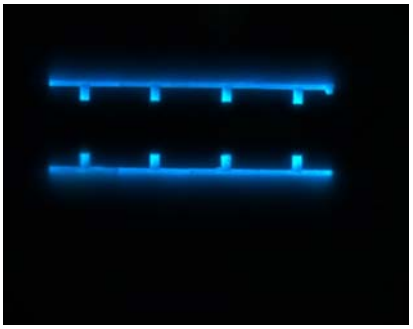


Figure 1 Fluorescence from a 3D structure functionalized with peptides

ABSTRACT: P I.23

Comparison of the magnetic behavior between Co- and Ni-nanostructures in silicon

K. Rumpf[1], P. Granitzer[1], P. Pölt[2], S. Šimić[2], H. Krenn[1]

[1] Institute of Physics, Karl Franzens University Graz, Unversitaetsplatz 5, 8010 Graz, Austria, email: klemens.rumpf@uni-graz.at, [2] Institute for Electron Microscopy, University of Technology Graz, Steyrergasse 17, 8010 Graz, Austria

The incorporation of Ni- and Co-nanostructures into a porous membrane exhibits different magnetic and optical properties. The insertion of the metal into the pores is carried out during a galvanic process and both materials, Ni as well as Co are precipitated in using an adequate metal-salt solution. In case of nickel elongated, needle-like precipitations with a length up to a few micrometers are achieved. Cobalt precipitated under comparable deposition conditions exhibits mainly spherical and ellipsoidal particles with a maximum length of about 200 nm. Also the composition of a NiCo-electrolyte (Ni:Co 2:1) was used to get a broader avenue of physical properties of the nanocomposite. The non-magnetic silicon matrix with incorporated metal structures exhibits magnetic properties due to the kind of metal as well as the kind of precipitation. Magnetic characteristics like coercivity, squareness and anisotropy can be tailored in varying the geometry of the incorporated metal structures. The main-contribution to the magnetic anisotropy is caused by the shape of the particles and thus the offset of coercivity between easy axis and hard axis magnetization (magnetic field parallel and perpendicular to the pores) is enhanced with increasing elongation of the wires. The magnetic properties are correlated to the size and shape of the deposited particles (e. g. single domain, superparamag.) but also to their spatial distribution within the template which modifies the magnetic interaction between them. The metal-growth of Ni, Co and Cu within the pores differs drastically leading to specific characteristics.

ABSTRACT: P I.24

Comparative study of $Zn_{1-x}Al_xO$ thin films and nanostructures deposited by different chemical routes

George Kenanakis[1,2,3,4], Zacharias Giannakoudakis[3], Dimitra Vernardou[1,2,5], Emmanuel Koudoumas[1,6] and Nikos Katsarakis[1,2,4]*

[1]Center of Materials Technology and Laser, School of Applied Technology, Technological Educational Institute of Crete, 710 04 Heraklion, Crete, Greece, [2]Science Department, School of Applied Technology, Technological Educational Institute of Crete, 710 04 Heraklion, Crete, Greece, [3]University of Crete, Department of Chemistry, 710 03 Heraklion, Crete, Greece, [4]Institute of Electronic Structure and Laser, Foundation for Research & Technology-Hellas, P.O. Box 1527, Vassilika Vouton, 711 10 Heraklion, Crete, Greece, [5]University of Crete, Department of Materials Science and Technology, 710 03 Heraklion, Crete, Greece, [6]Electrical Engineering Department, Technological Educational Institute of Crete, 710 04 Heraklion, Crete, Greece
*katsan@iesl.forth.gr

Over the past years, the synthesis of ZnO has been the subject of intense research due to its potential applications in ultraviolet emitting diodes, gas sensors and transparent conducting thin films for solar cells. In this work, ZnO and ZnO:Al nanostructures and thin films were synthesized by chemical route techniques. The fabrication of versatile ZnO nanostructures with controlled morphology and high surface-to-volume ratio was achieved by aqueous chemical growth, a novel, simple, environmental-friendly and inexpensive method at mild temperatures. On the other hand, ZnO thin films were obtained both using sol-gel and spray pyrolysis. All samples were characterized using x-ray diffraction (XRD), scanning electron microscopy (SEM), Fourier transform infrared (FTIR) and UV - visible spectroscopy. It is revealed that the wurtzite ZnO structure is the only crystallographic phase detectable in all cases although the preferential orientation varies, depending on the growth conditions. The shape and the dimensions of the nanostructures were found to depend on the growth time, the concentration of the precursor solution and the dopant percentage. Transmittance measurements have shown that the ZnO thin films are transparent in the visible wavelength region. Their electrical and photocatalytic properties are investigated and discussed over a wide range of growth parameters.

ABSTRACT: P I.25

Quantum effects in thin silicon rich oxide films

Alfredo Morales[1*], Jorge Barreto[1], Carlos Domínguez[1], Mariano Aceves[2]

[1]IMB-CNM (CSIC), Campus UAB, 08193 Bellaterra, Barcelona, Spain, [2]INAOE, Electronics Department, Puebla, Pue., 72000, Mexico, *alfredo.morales@cnm.es

Formation of silicon nanoparticles (Si-np's) embedded in a silicon oxide matrix has become an interesting approximation in order to obtain light emitters devices, memory and even more an UV photodetector. Single electron devices (SED) are another interesting application for Si-np's, where the Coulomb blockade (CB) has been considered as the mechanism to ensure the manipulation of a single electron. However, it is known that to operate a SED at room temperature, the Coulomb charging energy (Ec) of a nanoparticle must exceed the thermal energy. Therefore, the nanoparticle size and its capacitance (Cnp) need to be quite small. Different efforts have been made in order to obtain Si-np's with controllable and reproducible size; however, most of them are complicated and not easy to accomplish. One technique frequently used in standard ICs technology is the low pressure chemical vapor deposition (LPCVD). Silicon rich oxide (SRO) films deposited by LPCVD exhibit a uniform silicon excess in depth and therefore a Si-np's narrow size distribution after thermal annealing.

In this work, electrical properties of thin SRO films with silicon excess of 4% and deposited by LPCVD were studied using MOS-like structures. In the process, Si-np's were created by a thermal annealing at 1100ºC during 180 minutes after deposition. Capacitance versus voltage exhibited down peaks in the accumulation region related to charge and discharge effects of Si-np's. Current versus voltage measurements showed down and up like steps, spike peaks and a clear staircase at room temperature.

From Si-np's average size of 0.95 nm (as calculated from dielectric constant of SRO film), Cnp and Ec were, respectively, 5.28×10^{20} F and 1.04eV, which is much larger than the thermal energy kT=0.026eV at 300K. The stair voltage calculated was 1.04V in good agreement with the experimental results. Therefore, these effects are related to Coulomb blockade effects in the silicon nanoparticles.

ABSTRACT: P I.26

Effects of Initial Conditions in Intersubband Population Dynamics of a Semiconductor Quantum Well

Evangelos Voutsinas[1,2], John Boviatsis[1], Emmanuel Paspalakis[3] & Andreas F. Terzis[2]

[1]Technological and Educational Inst. of Patras, 26334, Greece, [2]Physics Depart., School of Natural Sciences, Univ. of Patras, Patras 265 04, Greece, [3]Materials Science Depart., School of Natural Sciences, Univ. of Patras, 265 04, Greece

In this work we study the effects of electron-electron interactions on Rabi oscillations between two quantum well subbands under the interaction of the quantum well structure with a strong continuous wave electromagnetic field. This is a problem that has attracted some interest recently [1-5]. We consider only the first two subbands and use the nonlinear Bloch equations [6] for the description of the system dynamics. We also allow the system to be initially in an arbitrary superposition of the two lower subbands, in contrast to the results of Ref. [4] where the system was considered initially in the ground subband. We first apply the rotating wave approximation and present analytical solutions of the density matrix equations in the case that the decay and dephasing processes of the system are ignored. The analysis of these solutions reveal effects such as extended Rabi oscillations, symmetry-breaking transitions and self-trapping to the initial state for different parameters of the system and for different initial states. We also present numerical results for a specific quantum well structure beyond the rotating wave approximation and including the relaxation processes. The comparison of the numerical results with the analytical results allows us to set the limits of the analytical solution. We find that Rabi oscillations can occur in the two-subband system even in the presence of relaxation processes.

Acknowledgements: The authors acknowledge financial support by the "Archimedes-EPEAEK II Research Programme" co-funded by the European Social Fund and National Resources.

References

[1] A. A. Batista and D. S. Citrin, Phys. Rev. Lett. 92, 127404 (2004).
[2] A. A. Batista, Phys. Rev. B 73, 075305 (2006).
[3] E. Paspalakis, M. Tsaousidou, and A. F. Terzis, Phys. Rev. B 73, 125344 (2006).
[4] E. Paspalakis, M. Tsaousidou, and A. F. Terzis, J. Appl. Phys. 100, 044312 (2006).
[5] A. A. Batista and D. S. Citrin, Phys. Rev. B 74, 195318 (2006).
[6] A. Olaya-Castro, M. Korkusinski, P. Hawrylak, and M. Yu. Ivanov, Phys. Rev. B 68, 155305 (2003).

ABSTRACT: P I.27

Propagation Effects and Switching Properties of Electromagnetically Induced Transparency in a Quantum Dot Structure

Antonios Fountoulakis[1], Emmanuel Paspalakis[2] & Andreas F. Terzis[1]

[1]Physics Department, School of Natural Sciences, University of Patras, Patras 265 04, Greece, [2]Materials Science Department, School of Natural Sciences, University of Patras, Patras 265 04, Greece

Electromagnetically induced transparency (EIT) [1] is an important nonlinear optical phenomenon with several potential applications that has been observed in atoms, molecules, ion-doped crystals and semiconductor quantum wells. Several recent theoretical works have also studied the effect of EIT in semiconductor quantum dots [2-5]. In this work we analyze propagation effects in EIT in self-assembled InAs quantum dots embedded in bulk GaAs. The quantum system under study exhibits a three-level cascade-type structure and interacts with two pulsed electromagnetic fields, a weak probe field and a strong coupling field. We use the coupled Maxwell-density matrix approach for the theoretical description of the system. These equations are formulated in the rotating wave approximation and the slowly varying approximation, and are then solved numerically for a homogeneous assembly of quantum dots. We study the creation of matched pulses during the pulse propagation in the system [6] and the potential for all-optical switching due to EIT [7]. The dependence of these phenomena to the quantum dot system parameters (frequency and intensity of the coupling field, dephasing rates, etc) is also investigated.

References

1. M. Fleischhauer, A. Imamoglu, and J. P. Marangos, Rev. Mod. Phys. 77, 633 (2005).
2. C. J. Chang-Hasnain, P. C. Ku, J. Kim, and S. L. Chuang, Proc. IEEE 91, 1884 (2003).
3. J. Kim, S. L. Chuang, P. C. Ku, and C. J. Chang-Hasnain, J. Phys.: Condens. Matter 16, S3727 (2004).
4. S. Michael, W.W. Chow, and H. C. Schneider, Appl. Phys. Lett. 89, 181114 (2006).
5. P. Kaer Nielsen, H. Thyrrestrup, J. Mork and B. Tromborg, Opt. Express 15, 6396 (2007).
6. S.E. Harris and Z.F. Luo, Phys. Rev. A 52, R928 (1995).
7. H. Schmidt and R. J. Ram, Appl. Phys. Lett. 76, 3173 (2000).

ABSTRACT: P I.28

Structure and optical properties of natural biopolymers Chitin and Chitosan

Gabriel Luna-Bárcenas[1], Jose Louvier-Hernández[1], Yuri Vorobiev[1] and Jesús González-Hernández[2]

[1]CINVESTAV-IPN, Unidad Querétaro 76230, México, vorobiev@qro.cinvestav.mx
[2]CIMAV, Miguel Cervantes 120, Chihuahua, México, jesus.gonzalez@cimav.edu.mx

The chitin is natural polysaccharide that is found in the shell of mollusks, the backbone of squids, the cuticle of insects, etc. Chitin and its derivative chitosan are widely used in medical industry because of their biocompatibility, also as membrane for fuel cells, optical waveguiding material and electroactive polymer. We studied thin films of both materials prepared from purified solutions by evaporation. The optical properties were investigated with FTIR measurements; for both polymers they are very similar and characterized by two absorption regions, one at 250 – 500 nm, another at 900 – 1300 nm. Chitin and chitosan have practically the same parameters of a crystalline structure. We assume that these features (similarity of the structure and of the optical properties) are not just the coincidence but reflect the essential relation between the crystalline structure symmetry and the electronic transitions. The later was modeled on the basis of quantum mechanical Free Electron Molecular Orbital approximation, using the new type (mirror-like) boundary conditions. The calculations made on the basis of the known parameters of crystalline structure give reasonable agreement with the experimental spectra without any adjustable parameters.

ABSTRACT: P I.29

Theoretical description of energy spectra of nanostructures assuming specular reflection of electron from the structure boundary

Yuri Vorobiev[1], Paul Horley[1,2], Petro Gorley[3], Vitor Vieira[2]

[1]CINVESTAV-IPN, Unidad Querétaro 76230, México, vorobiev@qro.cinvestav.mx, [2]Centro de Física das Interacções Fundamentais (CFIF), 1049-001 Lisboa, Portugal, [3]Physical Electronic Depart., Chernivtsy Nat. Univ., 87012 Chernivtsy, Ukraine. horley@cv.ukrtel.com

The quantum mechanical description of an electron in a nanostructure (like quantum dot, quantum well, organic dye molecule, etc.) strongly depends upon the boundary conditions applied. The classic free electron molecular orbital approximation uses the *impenetrable walls* conditions which could only be applied to the structures of the simplest geometry, and do not reflect the real character of interaction of an electron with the structure's boundary, which in many cases is a specular (mirror-like) reflection. We attempted to introduce the "mirror" boundary conditions in the treatment of a particle (electron) confined in quantum wells (nanostructures) of the different geometry, assuming that for any point inside the well we could find the corresponding points reflected by all the structure "walls", and write the boundary conditions as equivalency of Ψ-functions in real and reflected points. We show that for structures of sufficiently high symmetry these conditions are equivalent to the *cyclic* ones considering that the quantum well studied together with its reflections form a periodic structure. The new "mirror" boundary conditions could be applied to variety of cases (nanostructure's geometry) where the classic conditions are not applicable. Some examples are given (treatment of structures of triangular and spherical shapes), including the comparison between calculations and experimental data. In all cases analyzed, a reasonable agreement between theory and experiment was obtained, without any adjustable parameters.

ABSTRACT: P I.30

Photoluminescence of self-assembled single quantum dots in the linear regime

A. Zora[1], C. Simserides[1,2] and G. P. Triberis[1*]

[1] University of Athens, Physics Department, Panepistimiopolis, Zografos, GR-15784, Athens, Greece, [2] University of Patras, Materials Science Department, Panepistimiopolis, Rio, GR-26504, Patras, Greece, *gtriber@phys.uoa.gr

We present a quantum-mechanical theory for the interaction of light and electron-hole excitations in semiconductor quantum dots. The total Hamiltonian consists of the free-carrier, the free-photon, the electron-hole interaction Hamiltonian, and the interaction of carriers with the background photon field Hamiltonian. Applying the Heisenberg equation of motion to the photon number expectation values, to the electron (hole) distribution functions, and to the correlation term between the photon generation (destruction) and electron-hole pair destruction (generation), we obtain a set of luminescence equations [2]. Assuming quasi-equilibrium conditions, we solve analytically the above luminescence equations in the linear regime $(1 - f^{\mu e} - f^{\nu h} \approx 1)$, and we find an approximate solution of the incoherent photoluminescence intensity:

$$I_{em}(\omega_{\mathbf{q}}) = \Im \sum_{\lambda} \frac{\int d^3\mathbf{r}\Psi^{\lambda}(\mathbf{r},\mathbf{r}) \int d^3\mathbf{r} \sum_{\ell} C_{\ell}^{\lambda *} \Phi^{\mu e *}(\mathbf{r}) \Phi^{\nu h *}(\mathbf{r}) f^{\mu e} f^{\nu h}}{E^{\lambda} - \hbar\omega_{\mathbf{q}} - i\gamma}$$

$\Phi^{\mu e}(\mathbf{r})$ and $\Phi^{\nu h}(\mathbf{r})$ are the single-particle envelope functions and $\Psi^{\lambda}(\mathbf{r},\mathbf{r})$ is the excitonic eigenfunction [3]. $\hbar\omega_{\mathbf{q}}$ is the photon energy, μe (μh) indices the different electron (hole) states and $\ell = \mu\nu$. The coupling with the environment is entered through a small damping constant γ. The validity of our theoretical analysis is tested interpreting the experimental findings reported by Matsuda et al. [4] for the room temperature emission spectra of a lens-shaped $In_{0.5}Ga_{0.5}As$ self-assembled quantum dot. Our theoretical predictions for the interlevel spacing as well as for the dephasing time are in a good agreement with the experiment.

[1] M. Kira, F. Jahnke, W. Hoyer, S. W. Koch, Progress in Quantum Electronics 23 (1999) 189.
[2] A. Zora, C. Simserides, G. Triberis, Journal of Physics: Condensed Matter, submitted.
[3] C. Simserides, A. Zora, G. Triberis, Phys. Rev. B 73 (2006)155313.
[4] K. Matsuda, T. Saiki, H. Saito, K. Nishi, Appl. Phys. Lett. 76 (2000) 73.

ABSTRACT: P I.31

Study of the influence of α-particles irradiation in AlGaAs/GaAs heterojunction structures

P. Georgakakos[1,*], G. Papaioannou[1], G. Konstantinides[2] and Z. Hatzopoulos[3]

[1] University of Athens, Solid State Physics Section, Panepistimiopolis Zografos , Athens 15784, Greece, [2] Microelectronics Group, IESL-FORTH , Heraclion 71110, Greece, [3] University of Crete, Department of Physics, Heraclion 71110, Greece, e-mail: pgeorgakakos@hotmail.com

The successful application of heterojunctions to various devices is mainly due to the epitaxial technology to grow lattice-matched isotype or anisotype heterojunctions with virtually no interface traps. Among the important applications of heterojunctions are the high electron mobility transistors (HEMTs), devices where the spatial separation between the donors and the conducting two-dimensional electron gas minimizes the ionized impurity scattering. Aim of the present work is to study the influence of the radiation of α-particles (5MeV) in Schottky diodes on CaAs/AlGaAs/GaAs double heterojunction structures. The investigation was performed by means of current-voltage and capacitance-voltage characteristics in temperatures between 180K and 440K. The introduction of lattice defects was detected with DLTS technique. The dependence of saturation current, ideality factor, barrier height, carrier concentration, as well as the series and leakage resistance as a function of radiation fluence were determined. It was noted that as the radiation fluence increases a) the carrier concentration decreases, b) the ideality factor, the saturation current and the leakage resistance are not affected while c) the barrier height and the series resistance increases. The temperature dependence of the above parameters revealed the thermally activated contributions and allowed the calculation of corresponding activations energies.

ABSTRACT: P I.32

Structure and photocatalytic performance of magnetic TiO_2-Fe_3O_4 composites for the degradation of propachlor

Vassiliki Belessi[1], Dimitra Lambropoulou[2], Radek Zboril[3], Vassilis Tzitzios[1], T. Albanis[2], D. Petridis[1]

[1]Institute of Materials Science, NCSR "Demokritos", Ag. Paraskevi Attikis, Greece, e-mail: v_belessi@yahoo.com, dpetrid@ims.demokritos.gr, [2]Department of Chemistry, University of Ioannina, Ioannina 45110, Greece, e-mail:dlambro@cc.uoi.gr, talbanis@uoi.gr, [3]Department of Chemistry, UniveDepartment of Physical Chemistry and Nanomaterial Research Centre, Palacky University, Svobody 26, 77146 Olomouc, Czech Republic, e-mail: zboril@prfnw.upol.cz

Semiconductor photocatalysts have attracted much attention because of their potential application in the removal of organic and inorganic species from aquatic environments. TiO_2 is the most promising photocatalyst for environmental applications. A major disadvantage though is the need of an additional and expensive separation step involving the removal of the photocatalyst from the treated water. To overcome this problem magnetically separable photocatalysts have been developed permitting the recovery of the photocatalyst by an external magnetic field.

There have been two approaches in improving the magnetic photocatalytic systems. The first includes Fe_3O_4 or γ-Fe_2O_3 as magnetic core while the second approach includes spinel-like ferrites. As much as the first approach is concerned, some of the photocatalytic systems are composed of two (TiO_2-Fe_3O_4 or γ-Fe_2O_3) or three (TiO_2-SiO_2-Fe_3O_4 or γ-Fe_2O_3) parts. The SiO_2 membrane, between the Fe_3O_4 or γ-Fe_2O_3 core and the TiO_2 shell, has been found to promote the photocatalytic activity by preventing the injection of charges from TiO_2 particles to Fe_3O_4 or γ-Fe_2O_3 particles.

In the present work, we have developed magnetic separable photocatalysts TiO_2-Fe_3O_4 with enhanced photocatalytic properties where the role of SiO_2 membrane has been replaced with a narrow shell of polyelectrolytes.

Four materials with different loading by weight of Fe_3O_4 (3, 10, 15 and 20 %) were prepared and characterized by several techniques including XRD, FTIR, Mössbauer, SEM, TEM and magnetic measurements. The photocatalytic efficiency of the nanocomposite catalysts was evaluated using a chloroacetanilide herbicide (propachlor) as model compound. The primary degradation of propachlor followed pseudo-first-order kinetics according to the Langmuir–Hinshelwood model. All the magnetic composite photocatalysts exhibit good photocatalytic activity and their overall removal efficiency was comparable to that of the best commercial catalyst, Degussa-P25. The best photocatalytic efficiency for propachlor decomposition was observed for the sample containing 20% of Fe_3O_4.

ABSTRACT: P I.33

Study of the early stages of Cr/4H-SiC(11-20) interface formation and its behavior at high temperatures

I. Dontas*, S. Karakalos, S. Ladas and S. Kennou

Department of Chemical Engineering, University of Patras and FORTH-ICE/HT, P.O. Box 1414, GR-26500, Patras, Greece, * dontas@chemeng.upatras.gr

Metal/SiC interfaces are important for high temperature and high power microelectronic devices because of the high breakdown field and the wide band gap of SiC. Chromium on SiC is an interesting system for applications in SiC-based integrated-circuit technology as a Schottky barrier contact. We report on the early stages of the Cr/4H-SiC(11-20) interface formation at room temperature and the influence of annealing on this contact, by using XPS, LEED and Work Function (WF) measurements. Chromium was evaporated stepwise in UHV up to a thickness of about 3 nm and then the film was heated gradually up to 1170K. After each deposition or annealing step, XPS and WF measurements were taken. Upon Cr deposition, the binding energy of the XPS $Cr2p_{3/2}$ core level peak decreased gradually to a value corresponding to metallic Cr film formation, whereupon the binding energies of the substrate XPS core level peaks remained practically stable. The WF exhibited a steep decrease from the clean SiC substrate value, upon submonolayer coverage and then increased gradually to saturation near the metallic Cr value for polycrystalline films. The height of the interfacial Schottky barrier was determined from XPS data at 1.2±0.1 eV. Annealing of the contact up to about 900K induced no substantial change of the substrate and the deposit signals and the Schottky barrier height increased slightly to 1.4±0.1 eV, indicating that the film was thermally stable. Further annealing up to 1170K caused drastic increase of the substrate signal and a corresponding decrease of the deposit signal indicating Cr coalescence to larger crystallites and partial exposure of the substrate. The results are compared with previous work on chromium contacts grown onto various 4H- and 6H-SiC single crystal surfaces.

ABSTRACT: P I.34

Effect of In composition in the bonding environment of In in InAlN and InGaN epilayers

M. Katsikini[1], F. Pinakidou[1], E. C. Paloura[1], Ph. Komninou[1], E. Iliopoulos[2,3], A. Adikimanakis[2,3], A. Georgakilas[2,3], E. Welter[4].

[1] School of Physics, Aristotle University of Thessaloniki, 54124 Thessaloniki, Greece.
[2] Physics Dept., University of Crete, 71003 Heraklion-Crete, Greece, [3] Microelectronics Research Group, IESL,FORTH, 71110 Heraklion-Crete, Greece, [4] HASYLAB, Notkestr. 85, 22603 Hamburg, Germany, e-mail: katsiki@auth.gr

Alloying of GaN with InN and AlN permits the fabrication of light emitting devices that operate in the spectral range from IR to UV. Additionally, $In_xAl_{1-x}N$/GaN heterostructures find applications in the construction of high – electron mobility transistors (HEMT's). The optical and electronic properties of the alloys depend on the band structure which is defined by the interatomic distances. Here we report on the bonding environment of In in $In_xAl_{1-x}N$ ($0.07<x<0.25$) and $In_yGa_{1-y}N$ ($0.7<y<1$) epilayers using extended X - ray absorption fine structure (EXAFS) spectroscopy. The EXAFS measurements were conducted in the fluorescence yield detection mode at C and A1 beamlines of the Synchrotron Radiation Laboratory HASYLAB. It is found that the In-N distance, in both the InAlN and the InGaN ternaries, is not strongly affected by the In content and it does not obey Vegard's law. This result is attributed to the high ionicity of the InN bond. Contrary to that, the In-cation distances (in the 2nd nearest neighbor shell) have values closer to those predicted by the law of Vegard. The distribution of the In – cation distances is bimodal with the In – Ga distance being slightly smaller than the In – In distance. The behavior of the InAlN alloys is similar to that of the InGaN with the difference between the In – Al and In – In distances being larger than the difference of the In – Ga and and In – In in the InGaN alloys. The In – N and In – cation distances determined by EXAFS are compared with published theoretical calculations.

Acknowledgment: This work was supported by the EC under the contract MRTN-CT-2004-005583 (PARSEM).

ABSTRACT: P I.35

Electron microscopy investigation of extended defects in non-polar gallium nitride layers deposited on r-plane sapphire

J. Smalc[1*], Ph. Komninou[1], J. Kioseoglou[1], S.-L. Sahonta[1], G. Tsiakatouras[2], A. Georgakilas[2]

[1]Depart. of Physics, Aristotle Univ. of Thessaloniki, 54124, Greece, [2]Microelectronics Research Group, Depart. of Physics, Univ. of Crete, 71003 Heraklion, Greece and IESL, FORTH, P.O. Box 1527, GR 71110 Heraklion-Crete, Greece, julita@unipress.waw.pl

GaN-based optoelectronic device heterostructures are recently being fabricated on non-polar plane orientations, such as {1$\underline{1}$00} (m-plane) or {11$\underline{2}$0} (a-plane), in order to eliminate the quantum confined Stark effect caused by the internal piezoelectric fields present in (0001) polar GaN-based devices. Nitridation of the sapphire substrate surface prior the deposition of the epilayer improves its crystalline quality and reduces the large number of extended defects that are commonly observed in non-polar GaN films.

In this work, the interfacial structure of (11$\underline{2}$0)-GaN grown on (1$\underline{1}$02)-sapphire by Plasma-Assisted Molecular Beam Epitaxy (PAMBE) and the extended defects in the overgrown GaN layers are investigated using conventional and high resolution transmission electron microscopy (HRTEM). Prior to the deposition of GaN the sapphire surface has been nitridated either at 200°C or at 800°C for 2 hours. A thin AlN intermediate layer with an average thickness of about 1 nm, formed during the nitridation process at high temperature, is present between the GaN and sapphire. This interlayer relieves interfacial strain by reducing the in-plane lattice misfit between the GaN epilayer and sapphire, indicated by the reduction of the measured interfacial misfit dislocation spacing in comparison to the theoretical value for this orientation.

The extended defects observed in the GaN layers are predominantly a-type threading dislocations and basal stacking faults (BSFs), which originate from the GaN/sapphire interface. The threading dislocation density is slightly reduced in those films nitridated at higher temperatures, as is the density of inversion domains, although stacking fault density does not appear to change with nitridation conditions. Most BSFs are of the I_1 type, and are connected to prismatic stacking faults (PSFs) via a Frank-Shockley partial dislocation. Some BSFs of the I_2 type, bounded by Shockley partial dislocations, are also observed.

Acknowledgment: This work was supported by the EC under the contract MRTN-CT-2004-005583 (PARSEM).

ABSTRACT: P I.36

Micropores modification in InP

D. Nohavica[1], P. Gladkov[1], Z. Jarchovsky[1], J. Zelinka[1], Ph. Kominnou[2*], A. Delimitis[2], Th. Kehagias[2], Th. Karakostas[2]

[1]Institute of Photonics and Electronics, Academy of Science of the Czech Republic, Chaberska 57, CZ18251-Prague 8, Czech Republic, [2]Physics Department, Aristotle University of Thessaloniki, GR 54124 Thessaloniki, Greece, Email: komnhnoy@auth.gr

Porous III–V semiconductors attracted recently considerable attention due to the significant changes of their optical properties, such as photoluminescence intensity enhancement and blueshift. In this work we report on the formation, the structural and optical characterization of crystallographic oriented pores (CO) along <111>, <221> and <322> directions in InP.

Heat treatment of the current line oriented (CLO), and of all the three types of CO micropores of InP samples was realized in a hydrogen atmosphere and phosphorus protective ambience to prevent thermal dissociation. At 640°C and phosphorus overpressure approaching the dissociation pressure of the InP, both CO and CLO pores convert into "microbubbles" within 60 min. It is observed that the phosphorus vapour pressure (PVP) at temperatures 630÷650°C affects dominantly the mass transport process in InP. Experiments performed at different heat treatment conditions, using high phosphorus pressure ("phosphorus shower") and different compositions of InP-Sn melt or InP cover plate, revealed the PVP influence on the pores conversion process. Phosphorus shower seemingly suppresses the production of bubbles elongated in the microspores direction possibly due to the higher mass transport velocity.

The PL spectrum of thermally treated porous layers is quite similar to the one obtained from a reference sample (prior the porous formation), indicative for the reduction of structural defects generated during pores formation, as is also confirmed by electron microscopy observations. The lower integral PL in the thermally treated porous layers can be attributed to the comparable mean average distance between the microbubbles and the diffusion length for the non equilibrium carriers in InP. The "microbubbles" layers heat treated under "phosphorus shower" conditions exhibit higher PL intensity than samples protected by InP cover plate. Furthermore, the PL spectra are dominated by near band transitions instead of the impurity pair transitions. The possibility of overgrowing the microbubbles by nonizoperiodical InAs on InP heterostructures is also investigated.

Acknowledgement: The financial support from the GSRT under the ''Greece-Czech Republic Joint Research & Technology Programs 2005–2007'' is greatly acknowledged. The Czech team also acknowledges support by the Grand Agency of the Czech Republic No 202/06/1315 and the MSMT of the Czech Republic within the program Kontakt (project ME834).

ABSTRACT: P I.37

Growth of ternary $NiAl_xSi_{2-x}$ and $NiGa_xSi_{2-x}$ layers on Si(001)

A. Mogilatenko[1], F. Allenstein[2], A. Schubert[2], G. Beddies [2], H.-J. Hinneberg[2], W. Neumann[1]

[1]Institut für Physik, Humboldt-Universität zu Berlin, Newtonstr. 15, 12489 Berlin, Germany, e-mail: anmog@physik.hu-berlin.de, [2]Institut für Physik, Technische Universität Chemnitz, 09107 Chemnitz, Germany

Epitaxial growth of transition metal disilicides with CaF_2-structure ($CoSi_2$ and $NiSi_2$) on Si has been intensively investigated over past decades. Among all transition metal silicides $NiSi_2$ shows the smallest lattice mismatch of -0,5 % to Si. Despite the similarity of the crystal structures and the extremely low lattice mismatch the growth of closed uniformly oriented $NiSi_2$ layers on Si(001) is a difficult task. Recently, it has been shown, that substitution of Si by Al or Ga results in a change in the lattice parameter of bulk $NiSi_2$ [1]. The possibility to obtain thin defect-free epitaxial silicide layers with zero mismatch is challenging for both technological and fundamental research.

This study reports on the structure of thin ternary $NiAl_xSi_{2-x}$ and $NiGa_xSi_{2-x}$ silicide layers grown on Si(001) correspondingly by magnetron sputtering and molecular beam epitaxy. Deposition of a pure Ni film onto Si(001) at room temperature (RT) followed by annealing at 900°C results in formation of epitaxial (A- and B-type) $NiSi_2$ islands with $NiSi_2${111}/Si{111} interfaces. Codeposition of Al and Ni with atomic ratio Ni:Al = 1:*z* at RT followed by annealing at 900°C leads to the formation of closed epitaxial (A-type) layers, which grow predominantly with the $NiAl_xSi_{2-x}$(001)/Si(001) interface. The interfacial roughness strongly depends on the Al content and reaches its minimum for *z* ranging from 0.2 to 0.3.

Codeposition of Ga and Ni with a Ga content less than 0.17 followed by annealing at 900°C results in the island formation with a $NiGa_xSi_{2-x}$(220) || Si(001) texture, whereas a Ga content between 0.22 and 0.28 leads to formation of closed epitaxial $NiGa_xSi_{2-x}$ layers (A-type) with a preferential $NiGa_xSi_{2-x}$(001)/Si(001) interface.

Furthermore, addition of these alloying elements leads to a decrease in the nucleation temperature of the disilicide phase from about 700°C for pure $NiSi_2$ to lower than 500°C in the presence of Al or Ga.

[1] K.W. Richter, K. Hiebl, Appl. Phys. Lett. 83 (2003) 497

ABSTRACT: P I.38

Interface crystallography & capacitor properties of heterostructures based on advanced superionic conductors

A.V. Andreeva and A.L. Despotuli

Inst. of Microelectronics Technol.& High-Purity Mat., Russian Academy of Sciences 142432 Chernogolovka, Moscow Region, Russia

An interface engineering approach "*from advanced materials to advanced devices*" [1] is proposed as the basis for the development of new types of nanoionic supercapacitors with high frequency - capacitance characteristics [2]. The formation of high quality heterojunctions of advanced superionic conductor (AdSIC) - an electronic conductor (EC) is of the key role in the creation of these devices. AdSICs are crystals with a record high level of ionic conductivity σ_i and a low value of activation energy E~0.1 eV, such as α-AgI, $RbAg_4I_5$, etc. In [3] two classes of ionic nanosystems (NS) were distinguished: I) composites with high density of interfaces on the basis of solids with low σ_i; II) nanostructures of AdSICs. In class I, a noticeable σ_i arises due to generation of large concentrations of various point defects at interfaces. However, the value σ_i is still low and an activation energy *E* ~0.35 eV. The crystal structure of AdSIC with "channels" for moving ions is close to optimal for fast ionic transport (FIT), however it is disturbed on arbitrary heteroboundaries. This leads to suppression of FIT in NS of AdSIC (sharp decrease of σ_i and increase of *E*). Thus, defects influence contrarily on σ_i (and *E*) in NS-I and -II. Therefore in [3] a new scientific & technological discipline - "Nanoionics of advanced superionic conductors" was introduced. Fundamental challenge of nanoionics of AdSICs is conservation of FIT in NS of AdSICs.

Crystal chemistry & interface engineering methods at nanoscale allows to find the conditions and materials for synthesis of structure-ordered (coherent) AdSIC/EC interfaces with FIT in double electric layers (DEL) [4]. The formation of coherent AdSIC/EC heterojunctions and the creation of new types of nanoionic supercapacitors (NSC) with high frequency - capacitance characteristics [1,2] is discussed. These NSC characteristics are determined by atomic interface structure & relaxation time needed to charge DEL via the migration of ions through the bulk of AdSIC to the interface. To optimize structural design, to conserve FIT in DEL, forecasting and achievement of desirable characteristics the processes of internal structural self-organization should be in resonance with processes of applying external fields to control of AdSIC//EC interface structure (synergy resonance principle). This new approach to materials engineering [5] is discussed which is based on control of interface coherency and DEL thickness by crystallochemical constraints, including the misfit accumulated at interphase boundaries, elasticity, adhesion and common topology of symmetry elements of conjugated materials. Crystallochemical method for searching for structurally perfect AdSIC/EC interfaces includes [4]: 1) Determination and selection of lattice matched materials of AdSIC/EC heterojunctions; 2) Selection of epitaxial interface orientations respondent to symmetry dictated energy extremum; 3) Searching for conditions of good phase contacts of non-Faraday AdSIC/EC heterosystems based on thermodynamic constraints and comparison of mean orbit electronegativity and some energy characteristics; 4) The analysis of the FIT channel arrangement in AdSIC/EC heterostructures for a choice of high functional interfaces; 5) The application of external fields (composition, deformation, electric field etc.) of definite symmetry and accounting for the internal self-organization processes to obtain stable high-performance contacts.

REFERENCES

[1] Despotuli A.L., Andreeva A.V. "Creation of new type thin-film solid electrolyte supercapacitors for microsystem technology and micro(nano)electronics", Microsystem Technology (Rus) № 11. P. 2. N12, p.2 (2003).

[2] Despotuli A.L., Andreeva A.V., Vedeneev V.V., Aristov V.V., Maltsev P.P. "High-capacity capacitors for ultra-dense surface mount", Nano-Microsystem Technology (Rus), № 3, pp. 30-37, 2006

[3] Despotuli A.L., Andreeva A.V., Rambabu B. "Nanoionics of advanced superionic conductors", Ionics, 11, pp.306-314, 2005

[4] Andreeva A.V., Despotuli A.L. "Interface design in nanosystems of advanced superionic conductors", Ionics, 11, pp.152-160, 2005

[5] Andreeva A.V. " Interface design and processes of self-organization in nanosystems", Journal of Guangdong Non-Ferrous Metals, V. 2-3, pp. 244-250, 2005. (Selected Proceedings of the 8thChina-Russia Symposium on New Materials and Technologies).

ABSTRACT: P I.39

Endotaxial growth of InSb nanocrystals on the bonding interface of silicon-on-insulator structure

Ida E. Tyschenko[1], Matthias Voelskow[2], Alexander G. Cherkov[1], & Vladimir P. Popov[1]

[1]Institute of Semiconductor Physics, Russian Academy of Science, Novosibirsk, 630090, Russia, e-mail: tys@isp.nsc.ru
[2]Institute of Ion Beam Physics and Material Research, 01314 Dresden, Germany

Strong decrease in the carrier mobility of the nanometer-thick silicon films imposes a limitation on the application of silicon-on-insulator (SOI) structures in the current silicon planar CMOS technology. It is known that electron mobility in InSb matrix is about 77000 cm^2/Vs. This is about 50 times more than that in bulk silicon. The formation of Si/InSb on insulator heterostructures may provide an increase of effective electron mobility in the nanometer scale SOI films. Crystallization of InSb phase as result of annealing of the SOI structures implanted with Sb^+ and In^+ ions near the bonding interface was investigated. Two kinds of the ion-implanted SOI structures were prepared. First kind of the structures contained the buried SiO_2 layer implanted with In^+ and Sb^+ ions near the top Si/SiO_2 interface. In second kind, the ion-implanted regions were placed on each side of the bonding interface: Sb^+ ions were implanted into Si film; In^+ ions were implanted into SiO_2 layer. Rutherford backscattering spectrometry (RBS) and cross-sectional high-resolution electron microscopy (XTEM) were employed to study the properties of the prepared structures. The formation of unstrained InSb nanocrystals was observed within the SiO_2 bulk from first kind of the SOI structures as annealing temperature increased to 1100° C. The spherical-shape nanocrystals possessed with a diameter of 15-25 nm. In the case of the double-side implanted SOI structures, an increase in annealing temperature to 1100° C was accompanied by the up-hill diffusion of In atoms from the SiO_2 bulk toward the bonding interface and by the endotaxial growth of InSb nanocrystals on the top Si/SiO_2 interface. The nanocrystals observed on the bonding interface were 10-20 nm wide and 20-40 nm length. It is concluded from the experimental results that Sb atoms are the nucleation centers of InSb phase.

ABSTRACT: P I.40

Influence of Ammonia and Parabenzoquinone Molecules Adsorption on Photoluminescence Properties of Silicon Nanocrystals Ensembles

Yury V. Ryabchikov, Alexander S. Vorontsov, Luybov A. Osminkina, Victor Yu. Timoshenko, Pavel K. Kahkarov

Faculty of Physics, Moscow State University, Leninskie Gory, Moscow 119992, Russia, yury_r@vega.phys.msu.ru

The silicon nanocrystals ensembles (nc-Si) of porous silicon (PS) are interesting objects to study adsorption-induced recombination processes in low-dimensional semiconductors. Optical and electrical properties of nc-Si are sensitive to ambient because of large specific surface area of PS. We have investigated the adsorption effect of ammonia (NH_3) and parabenzoquinone ($C_6H_4O_2$) molecules on photoluminescence (PL) and electron paramagnetic resonance (EPR) spectra of PS. PS were fabricated by electrochemical etching of p-type c-Si wafers (ρ=10-20 $\Omega\cdot$cm) during 1 hour in 1:1 solution of hydrofluoric acid and ethanol with etching current density was 50 mA/cm^2. The porosity of PS was 70% and the thickness was 30 μm.

The PL of PS is well described by a model of exciton recombination in Si nanocrystals. According to this model the PS PL spectrum is a result of competition of radiative exciton annihilation in Si nanocrystals distributed by size and nonradiative recombination at surface defects (silicon dangling bonds). Adsorption can influence both recombination channels.

Adsorption of NH_3 and $C_6H_4O_2$ molecules leads to the quenching of PS PL. The PL quenching of PS is controlled by exciton destruction, which is caused by the local electric fields of Coulomb centers $(NH_3)^+$ and $(C_6H_4O_2)^-$ adsorbed on the PS surface. The decrease of the PL decay time also takes place. It can be explained by an enhancement of the nonradiative recombination in PS. A narrowing of the PL spectra of PS after the NH_3 and $C_6H_4O_2$ adsorption can be explained by an effect of electric fields of the adsorbed molecules, which can destroy strongly excitons in smaller Si nanocrystals.

The results of present work can be useful both from the fundamental point of view (knowledge of the interaction mechanisms between Si nanocrystals and adsorbed molecules) and for practical applications (for example to develop gas sensors based on PS).

ABSTRACT: P I.41

Efficient IR Emission from Patterned Thin Metal Films on a Si Photonic Crystal

P. Theodoni [a], P. Bayiati [a], M. Chatzichristidi [a], T. Speliotis [b], V. Vamvakas [a], I. Raptis [a], and N. Papanikolaou [a]

[a] Institute of Microelectronics, NCSR "Demokritos", Ag. Paraskevi, Athens, GR-15310, Greece, phone: +30-210 6503245. e-mail: N.Papanikolaou@imel.demokritos.gr
[b] Institute of Material Science, NCSR "Demokritos", Ag. Paraskevi, Athens, GR-15310, Greece

There has been increased interest on the optical properties of periodic arrays of subwavelength holes on a thin metal film since they show extraordinary transmission, higher than the one expected by normal diffraction, for both optical and infrared (IR) frequencies. Additionally, the combination of such patterned thin metal films with photonic crystals can lead to a narrow band thermal emission at a wavelength near the lattice spacing, which differs significantly from the black body spectrum. According to Kirchhoff's radiation law the emission efficiency must equal the absorption efficiency, efficient, narrow band, IR emitters should have narrow band absorption. These structures have interesting applications as thermal emitters for thermophotovoltaic applications but also as chemical sensors in the IR. The aim of our work was to fabricate and study the IR spectra of patterned metal films on a Si photonic crystal using Fourier-transform IR spectroscopy. Initially an Al thin metal film on top of a Si substrate was patterned by a square periodic array of holes with a lattice constant of 5 μm using optical lithography. The IR spectrum shows enhanced transmission close to the surface plasmon-polariton frequencies predicted for Al/Si and Al/air interfaces. Furthermore we etched the Si, with the Al as a mask, up to a depth of 5 μm and obtained a narrow band absorption spectrum for wavelengths close to the lattice constant. We have studied the influence of the geometrical parameters on the IR spectra while replacing Al with Au gave similar IR response. In conclusion we have fabricated a narrow-band IR emitter by periodic patterning of metallic thin films of a Si substrate.

ABSTRACT: P I.42

Anodic Porous Alumina Thin Films on Si: Interface Characterization

V. Gianneta[1], S. N. Georga[2], C. A. Krontiras[2], A. G Nassiopoulou[1]

[1]IMEL/NCSR Demokritos, P.O Box 60228, 15310 Athens, Greece
[2]Department of Physics, University of Patras, 26504 Patras, Greece
vgianeta@imel.demokritos.gr

Porous alumina thin films (thickness ~ 50nm), on Si were fabricated by anodization of thin Al films, under constant voltage of 20 V in sulphuric acid aqueous solution. The films show cylindrical vertical pores of diameter ~ 13-15 nm, arranged in hexagonal close packed structure. Electrochemical oxidation of the Si substrate through alumina resulted in the formation of SiO_2 dots at each pore tip. Different films, with or without SiO_2 dots at pore tips, were characterized by electrical measurements. C-V and G-V measurements were performed in the voltage range +1.0V to –3.0 V in steps of 0.05V and in the frequency range 1MHz to 100Hz. The typical form of C-V and G-V curves of a Metal-Insulator-Semiconductor (MIS) structure was obtained. C-ω and G-ω measurements were performed as a function of the applied gate voltage in the depletion region in order to determine the interface trap density D_{it} and interface trap time constant τ_{it}. D_{it} and τ_{it} were evaluated following the Conductance Method. The evaluated D_{it} values for samples with SiO_2 dots at each pore tip are of the order of $10^{11}eV^{-1}cm^{-2}$. On the other hand samples without SiO_2 dots exhibit larger D_{it} values

ABSTRACT: P I.43

Composition Analysis of Ternary Semiconductors by Combined Application of Conventional TEM and HRTEM

Ines Häusler, Holm Kirmse, Wolfgang Neumann

Humboldt-Universität zu Berlin, Institut für Physik, AG Kristallographie, Newtonstraße 15, 12489 Berlin, Germany

The tailoring of electronic and optical properties of nanostructured semiconductor materials for device applications requires the characterisation of the structure and the chemical composition.
In order to analyse the composition of ternary layers a new method was developed basing on transmission electron microscopy techniques (TEM). The method combines the analysis of chemically sensitive dark-field images with quantitative high-resolution TEM (HRTEM). For this characterisation the material system has to fulfil the following preconditions. First, the structure must show a chemically sensitive reflection. Secondly, the matrix material adjacent to the ternary layer has to contain only atomic species of the layer. This method will be demonstrated with a $GaAs_{1-x}Sb_x$/GaAs heterostructure system.
For this purpose Ga(As,Sb) were deposited on (001)-oriented GaAs substrate by means of metal-organic chemical vapour deposition (MOCVD). The pure material (GaAs, GaSb) as well as the alloyed ones ($GaAs_{1-x}Sb_x$) crystallize in the zincblende structure with a space group $F\bar{4}3m$. The misfit of about 8% between GaAs and GaSb leads to strained tetragonal Ga(As,Sb) unit cells with a space group $I\bar{4}m2$ and to a formation of 3-dimensional quantum dots (Stranski-Krastanov growth mode). Ga(As,Sb) has a chemical sensitive 002 reflection for both the unstrained and the tetragonal strained structure. This reflection was used for the compositional analysis. The 002 reflection intensities I^{002} were calculated depending on the Sb concentration x by the program jems [1].
For analysing 002 dark-field images the intensity curve must be normalized by a known concentration which is determined by quantitative HRTEM. For this purpose HRTEM images were digitally analysed using DALI (Digital Analysis of Lattice Images [2]) for visualising the strain distribution across the Ga(As,Sb) wetting layer. Using the displacement field $\vec{u}_z$ it was possible to measure the antimony concentration inside the wetting layer.

[1] jems, Electron Microscopy Software – java version, Copyright © P. Stadelmann 1999-2003, CIME-EPFL Switzerland
[2] A. Rosenauer, U. Fischer, D. Gerthsen, A. Förster, Ultramicroscopy 72 (1998), p. 121.

ABSTRACT: P I.44

Polyoxometalate-Based Multilayers: Fabrication and Electrical Characterization

A. M. Douvas[1*], E. Makarona[1], D. Velessiotis[1], J. A. Mielczarski[2], E. Mielczarski[2], N. Glezos[1], P. Argitis[1]

[1]Institute of Microelectronics, NCSR Demokritos, 15310 Aghia Paraskevi, Athens, Greece, [2]LEM, INPL/CNRS, UMR 7569, B.P. 40, 54501 Vandoeuvre-lès-Nancy, France, [*]Corresponding author: e-mail: adouvas@imel.demokritos.gr

A variety of POM-based materials have been proposed in the literature as candidate molecular electronics materials. The selection of POMs as the basic electronic component in these molecular materials is based on their unique electronic properties, and especially of POMs with Keggin structure, to function as electron reservoirs, i.e. to accept more than one electron and to delocalize the added electrons to several metal centers of their framework without significant changes of their structure. Other significant characteristics of POMs, which are also characterized as zero dimensional semiconductors, include well-defined structure and low charging energies from widely used electrodes such as Al and Au.
In this paper, polyoxometalate (POM)–based multilayers have been fabricated onto silicon wafers with aim to study their electron transport properties, and to relate these properties with the structural characteristics of these multilayers. The fabricated structures consisted of hybrid alternate layers of a Keggin structure POM, 12-tunstophosphoric acid, and a long alkyl chain diamine, 1,12-diaminododecane (DD). The silicon wafers have been initially chemically modified with 3-aminopropyl triethoxysilane (APTES) in order to generate amino groups on the silicon surface. Then, the alternate POM-DD layers were fabricated using the widely known layer-by-layer (LBL) self-assembly method, in which electrostatic interactions between POM and DD and initially between APTES and POM take place.
The fabrication process of the POM-based multilayers was extensively studied with UV-Visible and FTIR spectroscopy, a study that gave us the capability to fabricate these layers with a controllable and reproducible way. Three process parameters were mainly studied: (a) the concentration of POM and DD solutions, (b) the nature of the DD solvent, and (c) the pH of the DD solution, from which the third one was proved a key process parameter. The electrical characterization of these multilayers showed the charging capability of POMs and the dependence of the conduction mechanism on the structural characteristics of the layers, with tunneling being the dominant electron transport mechanism in most of the cases.

ABSTRACT: P I.45

Recharging of silicon nanocrystals embedded into oxide matrix: Q-DLTS study

I.V. Antonova[1], E.P.Neustroev[2] , S.A.Smagulova[2], Z.S. Yanovitskaya[1], J. Jedrzejewski[3] and I. Balberg[3]

[1]Inst. of Semiconductor Physics, Lavrentieva 13, 630090, Novosibirsk, Russia, antonova@isp.ncs.ru, [2]Yakutsk State Univ., Belinskogo 58, 677891, nefim@yandex.ru, [3]The Racah Inst. of Physics, The Hebrew Univ., 91904, Israel, balberg@vms.huji.ac.il

Arrays of semiconductor nanocrystals (ncs) form a class of "nanocomposite" materials, which properties result from strong quantum confinement, single-electron charging of individual particles and interaction between neighboring particles through these effects. Considerable interest to such nanocomposite materials is based on possible application of these materials to single-electron transistors, nonvolatile memories, electron emitters, optoelectronic devices, and the development of other nanoscale devices. Single electron tunneling and charging effects in nanocrystals (quantum dots) and their potential applications in single electron devices have been extensively studied for more than a decade, not only as physical phenomena in nanostructures, but also as operating principles for future integrated circuit.

Our ncs-Si/SiO_2 structures were deposited on silicon substrate using the co-sputtering technique. Subsequent annealing in nitrogen ambient is well known to yield the formation of silicon nanocrystals in the oxide. Applying this technique, the Si phase content in SiO_2 layer with thickness of 750 nm is varying along the substrate between 5 and 90 volume %. Charge deep level spectroscopy was used for study of the charging effects in nanocrystals as a function of the excess Si content in SiO_2 layer.

Deep level connected with recharging of nanocrystals is observed in Q-DLTS spectra. Q-DLTS peak corresponded to recharging of ncs is appeared in spectra for 10-15 vol % of Si content in oxide and higher. Energy and number of peaks in Q-DLTS spectra are depend on the Si content. Carrier cross section on the level is increased with increase in the Si content. Q-DLTS data are compared with results of capacitance-voltage or current voltage measurements. Specific features of nanocrystal recharging are discussed in the report.

ABSTRACT: P I.46

Carrier gas composition and growth temperature dependence of ELO GaN grown by HVPE

O. Gourmala, J. Tourret, A. Trassoudaine, Y. Andre, R. Cadoret, D. Castelluci, E. Gil

LASMEA Université Blaise Pascal Clermont II, France

Due to its excellent properties (high thermal and chemical stability), gallium nitride (GaN) is a wide band gap material which presents a considerable interest for short wavelength and high power high frequency electronic applications. At present, the main problem is that there is currently no cheaper GaN substrate available. So GaN and heterostructures are grown by heteroepitaxy on "foreign" substrates, mainly sapphire. The lattice mismatch and the thermal expansion coefficient lead to a high density of dislocations which is one of the limiting factors for devices performance.

To get sufficiently large GaN substrates (2 inch), there is an approach which consists in the growth of thick layers of GaN on sapphire or another substrate and subsequently to remove the template to get a free-standing GaN layer. Thus Hydride Vapour Phase Epitaxy (HVPE) seems to be the efficient method for this; it remains the technique which provides the highest growth rate capabilities, up to hundred of microns per hour, and a perfect intrinsic selectivity. By combining with epitaxial lateral overgrowth (ELO), the dislocation density can be significantly reduced. Indeed, ELO-HVPE (Epitaxial Lateral Over-growth) technique which consists in a structurally controlled GaN growth in line patterns and dot patterns substrates followed by thickening is a current promising route to reduce dislocation density in thick GaN layers (up to 6×10^6 cm^{-2} [1]).

In this work, ELO HVPE experiments were performed on patterned GaN/sapphire substrates and directly on c-plane patterned sapphire substrate in a 2 inch home-made reactor. Various experimental parameters such as carrier gas composition and growth temperature were investigated in the purpose of analysing their influence on the crystal growth morphologies and the vertical and lateral extensions. A phenomenological GaN model correlated with experiments has been developed. This theoretical approach is a powerful method for monitoring near-equilibrium HVPE experiments. It is based on physical analysis including thermodynamical and kinetic modelling and takes into account a growth mechanism involving the Cl desorption by GaCl as $GaCl_2$ and an etching reaction by HCl [2-4]. So, experimental conditions, supporting a high lateral growth rate were deduced, in order to produce thick layers with a high quality and a low dislocation density [1].

High quality uniform GaN films about 10 µm thick were successfully grown after ELO and coalescence process on sapphire substrates. Emphasis is placed on this result: GaN templates can be grown in a single HVPE reactor, directly on low cost sapphire substrates, after the ELO growth process and the control of coalescence of stripes and further thickening by altering the experimental conditions to favour a high vertical growth rate. HVPE ELO appears then as a reliable tool for growing high quality continuous GaN films to be thickened for the production of GaN quasi-substrates. Dislocation density measurements, photoluminescence (PL) and atomic force microscopy (AFM) characterisations are in progress.

[1] Y. Andre, A. Trassoudaine, J. Tourret, R. Cadoret, E. Gil, D. Castelluci, O. Aoude, and P. Disseix. Journal of Crystal Growth, Available on line (doi; 10.1016/j.crysgro.2006.12.081)
[2] E.Aujol, A.Trassoudaine, D.Castelluci and R.Cadoret. Mater. Sci. Eng. B 82 (2001) 65
[3] A. Trassoudaine, R. Cadoret, Evelyne Gil-Lafon. J. Crystal Growth 260 (2004) 7
[4] A. Trassoudaine, R. Cadoret, E. Aujol. Nitride Semicond., Handbook on Mater.& Devices. Wiley-VCH, pp 1-46 (2002)

ABSTRACT: P I.47

NEW TECHNIQUE FOR THE PRODUCTION OF STRETCH-ALIGNED HIGHLY CONDUCTING AND SEMI-CRYSTALLINE POLYANILINE

E. K. Chatzidaki [1], N. K. Kanellopoulos [1] and N. Theophilou[1*]

[1] Materials & Membranes for Environmental Separations Laboratory, Institute of Physical Chemistry, N.C.S.R. "Demokritos", 15310 Ag. Paraskevi Attiki, Greece
*e-mail: theophilou@chem.demokritos.gr

It is well known today, that the alignment of a polymeric conducting system is of great importance, due to an increase of anisotropy in the mechanical, optical, magnetic and electrical properties of the polymer (parallel to perpendicular the stretch-alignment direction).
New techniques were developed in the past years for the stretch-orientation of polyacetylene, polypyrolle, polythiophene and polyparaphenylene vinylene polymers. The highest optical and electrical anisotropy ratio obtained with polyacetylene, were between 30 and 100, while polyaniline has been considered since recently as an amorphous polymer, with very small crystallites.
A new technique is reported here, to increase crystallinity and molecular order of processable polymers. Especially semi-crystalline polyaniline with a coherence length up to 400 Å, has been obtained by annealing an amorphous polyaniline at temperatures between 100 and 200˚C.
These conditions were also applied during the stretch alignment of a polyaniline film. Draw-ratios (l/l_0) up to = 6 (l = final length, l_0 = initial length) were reached, with good microscopic orientation of the films shown by: wide angle-X Ray diffraction (WAXD), SEM and polarized FTIR spectroscopy.
The new polymers after doping with 1 M HCl solution, exhibit a conductivity (σ_{II}) of 100 S/cm, whereas the anisotropy in conductivity expressed as a ratio σ_{II} / σ_{I} is of 150.

ABSTRACT: P I.48

ZnO nanowire growth based on a low-temperature, silicon-compatible combinatorial method

Eleni Makarona[1,*], Thanassis Speliotis[2] , Giorgos Niarchos[1] , Dimitrios Niarchos[2] and Christos Tsamis[1]

[1] Institute of Microelectronics, NCSR "Demokritos", P. Grigoriou & Neapoleos, Aghia Paraskevi 153 10, Athens, Greece
[*] contact e-mail: elmak@imel.demokritos.gr
[2] Institute of Materials Science, NCSR "Demokritos", P. Grigoriou & Neapoleos, Aghia Paraskevi 153 10, Athens, Greece

ZnO is a wide-bandgap semiconductor (3.4eV) with a large exciton binding energy (60meV) at room temperature and for these properties has attracted a lot of attention for optoelectronic applications. However, ZnO has been demonstrated to have other equally important properties, such as conductivity and piezoelectricity that render it into a suitable material for nanopiezotronic applications.
With the latter in mind, we present in this work the application of a low-temperature, solution-based approach for the fabrication of Zno nanowires on patterned Si substrates. The method consists of a hydrothermal growth step atop a thin (<300nm) seeding layer of ZnO prepared by room-temperature radio frequency magnetron sputtering on Si (001) wafers. A mixture of aqueous solutions of zinc nitrate and hexamine in a water bath at 90°C constitutes the hydrothermal part of the method. The morphology and structural properties of the ZnO nanowires is studied using Scanning Electron Microscopy (SEM) and X-ray diffraction (XRD).
Three growth parameters are varied in order to obtain films suitable for nanopiezotronic structures: (1) the Ar pressure during the sputtering of the seeding layer, since it affects the grain size of the deposited film, which has a direct impact on the average diameter and orientation of the nanowires, (2) the time duration of the hydrothermal bath, since it affects the length of the nanowires, and (3) the geometry of the patterns, in order to clarify its potential role in the selective growth of the ZnO nanowires.

ABSTRACT: P I.49

Effect of deposition pressure and post deposition annealing on SmCo thin film properties

Thanasis Speliotis[1], Eleni Makarona[2], Federico Chouliaras[1], C. Charitidis[3], Christos. Tsamis[2] and Dimitris Niarchos[1]

[1]NCSR "Demokritos", Institute of Materials Science, 15310 Ag. Paraskevi Athens Greece, [2]NCSR "Demokritos", Institute of Microelectronics, 15310 Ag. Paraskevi Athens Greece, [3]NTUA, School of Chemical Engineering, Zographos, 157 80 Athens Greece

Since the discovery of $SmCo_5$ as an excellent bulk magnetic material in 1970's decade a lot of effort has been invested to acquire a better understanding of its magnetic properties and the optimal conditions of its fabrication process. Only little work however has been done in the field of thin permanent magnetic films. Today thin SmCo films hava attracted considerable interest for applications in microelectro-mechanical devices.
In this work we report on the microstructure and magnetic properties of SmCo films grown on Si[100] and thermally oxidized substrates. The influence of the resulting alloy compositions and the annealing conditions on the magnetic properties, phase transition and microstructural properties are presented.
The SmCo films were prepared by magnetron sputtering with a base pressure of 1×10^{-7} Torr. The working pressure was Ar and varied from 3 to 25 mTorr. The target was a 50-mm- diameter disk magnet with a composition of $Sm_{18}Co_{82}$. Samples were prepared by varying the deposition pressure p_{Ar} with a target power of 30 W and a target substrate-distance 5 cm at room temperature. The SmCo film thickness was 500 nm as calibrated by profilometry. A 100 nm Ta buffer and 100 nm cap layer were used to avoid the oxidation of the rare-earth metal Sm.
The deposition of SmCo films at room temperature resulted in amorphous samples as was confirmed by XRD measurements. The hard magnetic properties developed by the post deposition annealing under vacuum at temperatures up to 650 ^{0}C. In addition, the variation of deposition pressure affected the composition of the films and various SmCo phases from $SmCo^3$ to $SmCo^5$ developed
A high coercivity was achieved by annealing the films from 1kOe to 11kOe depending of the composition of the films.

ABSTRACT: P I.50

Influence of different substrates on the ionic conduction in $LiCoO_2/LiNbO_3$ thin-film bi-layers

E.E. Horopanitis, G. Perentzis and L. Papadimitriou*

Aristotle University of Thessaloniki, Department of Physics, Section of Solid State Physics, 54124 Thessaloniki, Greece, E-mail: pleonida@auth.gr ,

Thin films of $LiNbO_3$, deposited by e-gun evaporation, show lithium deficiency, which is cured by "Li doping". The "Li doping" of the films was achieved by preparing a structure of Li-Nb-O/Li/Li-Nb-O, which after annealing forms a homogenized $LiNbO_3$ layer because of diffusion of Li in the two Li-Nb-O layers. The intension is the $LiNbO_3$ electrolyte to be used either in Li-ion microbatteries or in electrochromic displays.
The $LiCoO_2/LiNbO_3$ bi-layers were prepared either on Stainless Steel/TiN or on Al_2O_3/Co/Pt substrates/ohmic-contacts by depositing first either the cathode $LiCoO_2$ or the electrolyte $LiNbO_3$. The Nyquist plots of the AC impedance measurements of all structures showed that the interfaces prepared on Stainless-Steel/TiN consisted of two semicircles. The structures deposited on Al_2O_3/Co/Pt showed a third semicircle, which is probably due to the roughness of the substrate. It is important that the ionic properties of the bi-layers with the cathode material deposited first, a usual structure in a microbattery, are improved compared to the other structures. The quality of the $LiNbO_3$ layer depends very much on the substrate. It can be evaluated from Arrhenius plots that the activation energy of this layer is considerably lower when the whole structure is deposited on Stainless Steel/TiN.

Keywords: e-gun evaporation, Lithium niobate, "Li-doping", Impedance spectroscopy, Interfaces

Acknowledgements: The present study is co-funded by European Union-European Social fund and the Greek National fund PYTHAGORAS – EPEAEK II.

ABSTRACT: P I.51

Nanodiamond formation in hydrogenated amorphous carbon thin films

S. Kassavetis, S. Lousinian, S. Logothetidis, I.Tsiaoussis, N. Frangis

Department of Physics, Aristotle University of Thessaloniki,
GR-54124 Thessaloniki, Greece

Carbon-based thin films are ideal materials for many cutting edge technological applications, as protective and active films for optoelectronic systems, gas barrier coatings for flexible electronic devices, due to their unique properties.[1]
Lately the scientific interest was attracted to the growth of nanocrystalline forms of carbon-based thin films and especially of the embedded nanodiamond structures into amorphous carbon films. In this work *rf* magnetron sputtering was successfully used for the growth of nanodiamond hydrogenated amorphous carbon thin films (a-C:H). The growth of the samples was held in a high vacuum chamber on c-Si(001) substrates, using Ar as the sputtering gas and H_2 as the reactive one.
Previous studies have shown that the a-C:H thin films are relatively soft (Hardness = 1.8–5.7GPa), with low density (1.1-1.3g/cm^3).[2] In this study, we focus on the effect of the deposition conditions, such as the applied to the substrate bias voltage (V_b) and the hydrogen partial pressure (P_H), to the surface morphology and to the nanostructure characteristics of the a-C:H thin films. The surface characterization of the a-C:H thin films was performed using various Scanning Probe Microscopy Techniques, such as AFM, Atomic Force Acoustic Microscopy and Scanning Near-field Optical Microscopy. It was found that the V_b controls the surface roughness and morphology, rather than the P_H. Also, High Resolution Transmission Electron Microscopy studies showed the presence of nanosized crystals (5–10 nm) embedded in the amorphous carbon matrix close the surface and crystalline seeds deeper in to the thin film, in the case of the a-C:H thin film grown with $V_b>0$. However, for $V_b<0$ the samples were almost amorphous. The electron diffraction patterns were identified with the characteristic diamond d-spacings.

[1] S. Logothetidis, Thin Solid Films 482 (2005) 9.
[2] S.N. Kassavetis, S. Logothetidis and G.M. Matenoglou, Surf. Coat. Techn. 200 (2006) 6400.

ABSTRACT: P I.52

Optical properties of two-dimensional arrays of metallodielectric nanosandwiches

N. Papanikolaou[a], G. Gantzounis[b], and N. Stefanou[b]

[a] Institute of Microelectronics, NCSR "Demokritos", Ag. Paraskevi, Athens, GR-15310, Greece, phone: +30-210 6503245, e-mail: N.Papanikolaou@imel.demokritos.gr
[b] Section of Solid State Physics, University of Athens, Panepistimioupolis, GR-157 84 Athens, Greece

Arrays of simple or composite metallic nanoparticles exhibit intriguing optical properties and are intensively studied over the last years. In the present communication we report a theoretical study of two-dimensional periodic arrays of metal/dielectric/metal layered nanoparticles using an efficient and accurate multiple-scattering method, which was originally developed for spherical objects and recently extended to non-spherical shapes. In particular, we consider arrays of two metallic nanodisks separated by a thin dielectric disk; we discuss the plasmonic excitations in such single nanosadwitches and study the influence of geometrical parameters like the thickness of the dielectric spacer and the metallic disks. Our results are compared with available experimental data on the optical properties of isolated nanosadwitches. Moreover, we investigate the interaction between the composite particles as they approach close to each other in a two-dimensional periodic lattice. Our results corroborate that such structures, with a tailored optical response, can be sensitive to small changes of the dielectric constant of the environment and have potential applications as chemical sensors, which detect small changes in the dielectric constant of fluids. The use of metallodielectric nanosandwiches as building units in the design of novel metamaterials is also anticipated.

ABSTRACT: P I.53

Depletion of parallel conducting layers in high mobility $In_{0.53}Ga_{0.47}As/In_{0.52}Al_{0.48}As$ modulation doped field effect transistors.

E. Skuras, A. Gavalas, D. Spathara, D. Anagnostopoulos
Department of Materials Engineering, University of Ioannina,
Ioannina 45110, Greece.

C.R. Stanley
Department of Electronics and Electrical Engineering, Oakfield Avenue,
University of Glasgow, Glasgow G12 8LT, United Kingdom.

In this paper we solve self-consistently the Poisson and Schrödinger equations for studying parallel conduction associated with the low mobility electrons near the donors in the $In_{0.52}Al_{0.48}As$ barrier layer of high mobility $In_{0.53}Ga_{0.47}As/In_{0.52}Al_{0.48}As$ modulation doped field effect transistors. Parallel conduction has a parasitic effect on the operation of field effect transistors and should be eliminated. Depletion of the parallel conducting layer is achieved through etching of the upper part of the un-doped $In_{0.52}Al_{0.48}As$ Schottky layer. Self-consistent calculations took no account of conduction band non-parabolicity which becomes significant when the total electron density N_S of the $In_{0.53}Ga_{0.47}As$ channel exceeds $2x10^{12}$ cm^{-2} [1, 2]. For studying electron depletion we use a specially designed hetero-structure consisting of an Fe-doped semi-insulating InP substrate, a 0.4 μm thick $In_{0.52}Al_{0.48}As$ buffer layer, a 30 nm thick $In_{0.53}Ga_{0.47}As$ channel, a 20 nm thick $In_{0.52}Al_{0.48}As$ spacer layer, a 10 nm thick Si slab-doped layer with a uniform distribution of $5x10^{12}$ cm^{-2} donors, a 40 nm thick $In_{0.52}Al_{0.48}As$ Schottky layer and finally a 10 nm thick Si^+ doped $In_{0.53}Ga_{0.47}As$ cap layer [3, 4]. The $In_{0.53}Ga_{0.47}As$ cap layer is removed by etching prior to the gate deposition. The Fermi level at the exposed surface of the un-doped $In_{0.52}Al_{0.48}As$ Schottky layer is pinned at 0.65±0.05 eV below the Γ-conduction band minimum [5, 6]. Two electron sub-bands are occupied in the $In_{0.53}Ga_{0.47}As$ channel with N_S = $1.4x10^{12}$ cm^{-2}. The total concentration of the low mobility electrons conducting in parallel to the channel is $2.0x10^{12}$ cm^{-2} and is also distributed in two sub-bands. Etching of the Schottky layer from 40 nm to approximately 10 nm, in steps of 1 nm, gradually depletes both the upper and lower sub-bands in the $In_{0.52}Al_{0.48}As$ barrier. After the depopulation of the upper sub-band the lower one is depopulated with increased rate allowing the density of the surface states at the position of the Fermi energy pinning to be calculated. During depletion of the parallel conducting layer N_S remains essentially unaffected. In fact N_S is decreased by only ~$2x10^{10}$ cm^{-2}. Similar data is calculated for δ-doped structures. Shubnikov-de Haas and Hall data, taken at 1.5 K in the dark, is presented.

References

1. M. McElhinney, B. Vögele, M.C. Holland, C.R. Stanley, E. Skuras, A.R. Long, E.A. Johnson, Appl. Phys. Lett. 68, 940 (1996).
2. E.A. Johnson, A. MacKinnon, Semicond. Sci. Technol. 5, S189 (1990).
3. E. Skuras, A.R. Long, B. Vögele, M.C. Holland, C.R. Stanley, E.A. Johnson, M. van der Burgt, H. Yaguchi, J. Singleton, Phys. Rev. B 59, 10712 (1999).
4. E. Skuras, C.R. Stanley, A.R. Long, E.A. Johnson, A. MacKinnon, H. Yaguchi, M. van der Burgt, J. Singleton, J. Appl. Phys. 86, 6593 (1999).
5. J.S. Hwang, G.S. Chang, W.C. Hwang, W.J. Chen, J. Appl. Phys. 89, 1771 (2001).
6. E. Skuras, C.R. Stanley, Appl. Phys. Lett., 90 (2007) articl

ABSTRACT: P I.54

Poisson ratio under compressive strain; effect on the mechanical response of the $Cu_{46}Zr_{54}$ metallic glass

L. Tayebi[1,@], Ch.E. Lekka[2], G.A. Evangelakis[1]

(1) University of Ioannina, Department of Physics, Ioannina 45110, Greece, (2) University of Ioannina, Department of Materials Science and Engineering, Ioannina 45110, Greece, email:ltayebi@cc.uoi.gr

We present Molecular Dynamics (MD) results demonstrating the effect of the Poisson ratio (PR) changes, occurring upon compressive deformation, on the mechanical response of $Cu_{46}Zr_{54}$ metallic glass (MG). We found that the PR value increases under strain, the effect being more pronounced after yielding. These changes are related to microstructural modifications occurring at subnano scale and to the plasticity of the material. In addition, we found that the effect depends on the imposed strain rate, yielding lower plastic region and fracture strain at high deformation rates. These findings indicate that microstructure, intrinsic properties and mechanical response of MGs are closely related and can be used for the design of MGs exhibiting enhance ductility.

Keywords: Bulk metallic glass; Plastic deformation; Molecular dynamics simulations

ABSTRACT: P I.55

Auger Recombination in Silicon Nanocrystals

M. Mahdouani[1], R. Bourguiga[1,a], S. Jaziri[1,a], S. Gardelis and A.G. Nassiopoulou[1]

[1] Lab. de Physique des Matériaux, [a] Faculté des Sci. de Bizerte, 7021, Tunisia, [2] [1]IMEL, NCSR Demokritos, 15310 Athens Greece

The nanocrystal (NC) quantum dots are especially interesting because they are a truly new form of matter that can be considered as "artificial atoms". They have linear discrete absorption spectra (like atoms) and photoluminescence tunable over a wide range, from the far infrared to the deep ultraviolet. These exciting properties lead to numerous potential and actual applications. Today when we talk seriously about NC applications, the significant role played by Auger process is especially important and must be studied, because they affect all aspect of carrier relaxation and recombination.

Auger recombination (AR) is the Coulomb scattering process in which an electron-hole pair recombines while the excess energy being taken by another carrier as opposed to giving rise to luminescence [1]. In the NCs, quantum-confinement enhances the AR rate compared to bulk by advancing the Coulomb interaction and relaxing the translational momentum conservation [2]. Therefore, AR is held largely responsible for the inefficient luminescence occurring in quantum dots and NCs. This becomes a major obstacle particularly in the case of silicon NCs, aiming for silicon-based light sources and promoting the realm of silicon photonics [3].The recent experimental studies confirm the importance of AR for Si NCs witch has become substantial [4, 5]. We note that the AR can be utilised as a desirable effect to switch off the photoluminescence in a Si optical NC memory [5]. Therefore, utilization and full control of AR requires a rigorous theoretical support.

In this work, we investigate the AR in Si NCs calculating the rate of Auger recombination process considering the cases of biexciton types resulting in excited hole and excited electron excitons. The effect of temperature on the AR will be studied and presented.

References

[1]. P. T. Landsberg, Recombinations in Semiconductors, (Cambridge University Press, Cambridge, (1991).
[2]. C. Delerue, G. Allan and M. Lannoo, Semiconductor and Semimetals 49, 253 (1998).
[3]. S., Ossicini, L. Pavesi and F. Priolo, Light Emitting Silicon for Microphotonics, Springer-Verlag, Berlin, (2004).
[4]. R. M'ghaïeth, H. Maâref, I. Mihalcescu and J. C. Vial, Phys. Rev. B 60, 4450 (1999).
L. Pavesi, L. Dal Negro, C. Mazzoleni, G. Franzo and F. Priolo, Nature 408, 440 (2000).
A.Irrera, D. Pacifici, M. Miritello, G. Franzo, F. Priolo, F. Iacona, D. Sanfilippo and P. G. Fallica, Appl. Phys. Lett. 81, 1866 (2002)
F. Cichos, J. Martin and C. von Borczyskwski, Phys. Rev. B 70, 115314 (2004).
R. J. Walters, G. I. Bourianoff and H. A. Atwater, Nature Materials 4, 143 (2005).
I. Sychugov, R. Juhasz, J. Linnros and J. Valenta, Phys. Rev. B 71, 115331 (2005).
[5]. R. J. Walters, P. G. Kik, J. D. Casperson, H. A. Atwater, R. Lindstedt, M. Giorgi, Bourianoff, Appl. Phys. Lett., 85, 2622 (2004).

CHARACTERIZATION

ABSTRACT: P I.56

Characterization of Electroless Copper Deposition into Porous Silicon

S. Sam[1, 2], N. Gabouze[1], S. Djebbar[2]

[1] UDTS, 02, Bd. Frantz Fanon, B.P. 140 Alger-7 merveilles, 16200 Algiers, Algeria, [2] USTHB, B.P. 32 El Alia, Bab Ezzouar, Algeria

Porous silicon has stimulated an intense interest mainly since the discovery of its photoluminescence and electroluminescence [1]. These properties confer to the material potential applications which can contribute to the development of the silicon optoelectronic technology [2]. However, porous silicon shows a very low electrical conductivity and a chemical instability due to its large internal surface. In the aim to improve the conductivity and stability of the porous silicon we proceeded to copper deposition into the porous layer using immersion plating method. This technique takes advantage of an interesting chemical property of porous silicon, namely its ability to act as a moderate reducing agent [3]. Porous silicon can effectively reduce from solution any aqueous metal ion system with a positive standard reduction potential with respect to that of standard hydrogen electrode [4]. It is apparent that noble metals would be ideally suited for this process. To check whether the metal entered the pores, the formed material was studied in the basis of the Scanning Electron Microscopy (SEM) observations. The results indicated that copper was diffused through the Porous layer at a thickness of about 0,7 μm. In addition, the samples were characterized using energy dispersive X-ray (EDX) and X-ray diffraction (XRD). Moreover, metal deposition mechanism and reactions involved during the deposition process were studied by mean of Fourier Transform Infrared spectroscopy (FTIR) which revealed that metal reduction reaction is accompanied by the oxidation of the silicon to SiO_2. Finally, recorded luminescence measurements indicated an efficient PL of the metallized porous silicon sample.

References

[1] L. T. Canham, Appl. Phys. Lett. 57 (1990) 1046.
[2] S. Belhousse, H. Cheraga, N. Gabouze, sensors and actuators chemical B in press.
[3] L. A. Porter, H. C. Choi, A. E. Ribbe and J. M. Buriak, Nano Lett. 10 (2002)1067
[4] I. Coultard, S. Degen, Y. J. Zhu et T. K Sham, Can. J. Chem. 76 (1998) 1707.
Keywords: Porous silicon, Copper, Immersion plating

ABSTRACT: P I.57

Electrical investigations of the InAs quantum dots in the AlO matrix

O.R. Bajutova, A.G. Milekhin,O.V. Naumova, A.I. Toropov, A. Gutakovsky

Institute of Semiconductor Physics, 630090 Novosibirsk ,Russia, bajutova@thermo.isp.nsc.ru

The technique of selective wet oxidation of Al(Ga)As has been widely used in the fabrication of various optical devices such as photon crystals[1], light emitting diodes, vertical-cavity quantum dot lasers. Oxidized Al(Ga)As layers are used as a current aperture for achieving both optical and electrical confinements and for making of a AlO/ GaAs distributed Bragg reflector mirrors with high reflection too. The application of this process to vertical cavity quantum dot lasers has led to significant performance improvements[2,3].

In this paper we report on using the technique of selective wet oxidation in the formation of InAs quantum dots in an AlO matrix and the investigation of optical and electrical properties. The InAs QD/AlO system can be considered as a promising candidate for possible application of as an active media for vertical cavity QD lasers because higher barriers of an aluminum oxide matrix produce shifts of the InAs QD bandgap energy.

The structure with InAs self – assembled quantum dots in an AlAs matrix was grown by molecular beam epitaxy on GaAs (001) oriented substrate. The lateral oxidation of the AlAs layers was then performed in horizontal quarz tube at 360^0C with N_2 as the carrier gas passing through a H_2O bubbler maintained at 95^0C.

Transmission electron microscopy results reveal, that the obtained AlO matrix has the amorphous structure. The optical investigations was performed by micro-Raman spectroscopy and micro-PL spectroscopy. Micro- Raman spectra measured from non-oxidised area reveals the phonon features at 274, 361 and 405 cm^{-1} attributed to LO GaAs-like phonon from InAs QDs and TO and LO phonons from AlAs layer, respectively. Intensity of the lines decreases when the laser spot approaches the oxidized area. No additional lines due the amorphous and crystalline As clusters observed earlier for InAs/AlAs QD structures [4] appear in the Raman spectra of annealed samples that reflect the improved selective oxidation procedure.

The current-voltage characteristics of structures was measured at different temperatures. One can see current jump in the I-V curve at room temperature and two peaks in the I-V curve at nitric temperature. This behavior of the I-V dependencies suggests the resonant tunneling through the states in Al_2O_3 dielectric. The comparison of the structures, prepared with different modes, it makes it possible to determine which of these states correspondent to the InAs QDs embedded in AlO dielectric matrix.

References:

[1] A.M. Yacomotti,F. Raineri, G. Vecchi at all , Appl.Phys. B **81**, 333-336(2005)
[2] J.J. Wierer, P.W. Evans, N Holonyak, and D.A.Kellogg, Appl. Phys. Lett. **72**, 2742(1998).
[3] Z. Zou, D.L. Huffaker, S.Csutak, and D.G. Deppe, Appl. Phys. Lett. **75,** 22(1999)
[4] D.A. Tenne, O.R. Bajutova, A.K Bakarov, A.K. Kalagin, A.G. Milechin, A.I. Toropov,D.R.T. Zahn, Tech. Phys. Lett. **28**, 554 (2002)

ABSTRACT: P I.58

Optical properties of InAlN(0001) alloys in the whole composition range

E. Iliopoulos[1], A. Adikimenakis, M. Androulidaki, G. Tsiakatouras and A. Georgakilas

Microelectronics Research Group, Institute of Electronic Structure and Lasers, Foundation for Research and Technology-Hellas, P.O.Box 1527, 71110 Heraklion-Crete, Greece; and Physics Department, University of Crete, Heraklion-Crete, Greece, [1] E-mail: iliopoul@physics.uoc.gr

Development of InAlN alloys is of particular importance for III-Nitrides heterostructure technology. Such ternaries can be compositionally tuned to lattice match or polarization match GaN layers. However, difficulties in their heteroepitaxial growth, up to now, hindered our knowledge of their basic properties.

In this work, a detailed study of their complex dielectric function, in the whole alloy composition range, was undertaken. InAlN layers, ~ 300 nm thick, were heteroepitaxially grown on AlN(0001)/Al_2O_3 templates by plasma-assisted molecular beam epitaxy. Their composition was determined by high resolution x-ray diffraction. For determining of their optical constants, spectroscopic ellipsometry, in the spectral range of 0.9 to 6.2 eV was employed, along with optical transmission. The optical model of the AlN/Al_2O_3 pseudosubstrate was derived, separately, in details. The examined alloy layers were found to be reasonably optically uniform.

Parametrization of InAlN alloys dielectric function, using Herzinger-Johs oscillators was found to be efficient in the description of the experimental data, while providing Kramers-Kronig consistency. Therefore, the alloy refractive index dispersion relations were obtained in the entire optical range investigated. The dependence of direct optical bandgap on alloy composition was found to deviate from the usual single-valued bowing coefficient description for alloys. The energy bowing parameter was found to monotonically increase with decreasing InN mole fraction.

ABSTRACT: P I.59

Optical Spectroscopy of Silicon Nanocrystals for Biomedical Applications

Yury V. Ryabchikov, Alexander S. Vorontsov,
Victor Yu. Timoshenko, Pavel K. Kahkarov

Faculty of Physics, Moscow State University, Leninskie Gory, Moscow 119992, Russia, e-mail: yury_r@vega.phys.msu.ru

Electronic and optical properties of silicon nanocrystal (nc-Si) assemblies prepared by electrochemical methods differ drastically from those of the bulk Si (c-Si). Besides the quantum confinement the properties of nc-Si of 1-5 nm sizes are strongly affected by surface treatment and molecular ambient. There are prospects for using silicon nanocrystals in photodynamic cancer therapy. For this biomedical application one needs nc-Si-based materials with controlled bioactive properties. Our work demonstrates the required approach to form such materials, which possess desirable structural, electronic, optical and bioactive properties.
The approach employed in present work is based on the electrochemical porosifying of c-Si wafers of certain specific resistivity in hydrofluoric acid solutions. The prepared free-standing porous Si (PSi) films were dried in air and then milled to get nc-Si powders. The nc-Si powder was dispersed in pure water bubbled with oxygen to form homogeneous aqueous suspensions. The dry PSi powder was investigated in vacuum and in ambient of oxygen molecules. The photoluminescence (PL) properties of nc-Si have been investigated and explained by the radiative recombination of excitons confined in the nanocrystals. The excitons are found to transfer non-radiatively their energy to oxygen molecules adsorbed on the surface of nc-Si. The PL spectroscopic experiments clarify that the energy transfer is mediated by the direct resonant electron exchange between photoexcited Si nanocrystals and oxygen molecules adsorbed on their surfaces. The singlet oxygen (SO) generation is observed for nc-Si both in gaseous and liquid ambiences. In particular, the PL intensity of nc-Si in oxygen-saturated water decreases by factor of 1.5-2 in comparison with that in oxygen-free water (or in vacuum). This fact indicates a high quantum efficiency of the SO generation. Our results have shown that the photosensitization of SO by nc-Si dispersed in water can be used for photodynamic cancer therapy.

ABSTRACT: P I.60

Cr/4H-SiC Schottky contacts investigated by electrical and photoelectron spectroscopy techniques

Koliakoudakis H.[2], Dontas J.[1], Kayambaki M. [2], Ladas S.[1], Konstantinidis G[2], Zekentes K.[2], Kennou S.[1]

[1] Department of Chemical Engineering, University of Patras and FORTH-ICE/HT, 26504 Rion, Patras, Greece, [2] MRG, IESL, FORTH, Vassilika Vouton, PO BOX 1527, 71110 Heraklion, Crete, Greece

Schottky contacts of metal/4H-SiC systems have been intensively investigated and the first commercially available SiC devices were Schottky diodes. The present paper describes the results of a systematic study of Cr/4H-SiC Schottky contact combining standard electrical measurements with photoelectron spectroscopy results. XPS measurements were recordered during the in-situ formation of the metal-semiconductor interface depositing Cr films thinner than 15nm. The room temperature I-V and C-V measurement results obtained on thick (50nm) Cr layers were used to determine barrier height and ideality factor. The effect of thermal annealing was studied in both experimental configurations.
The Schottky barrier height (SBH) for the Cr/4H-SiC interface was calculated from XPS data and upon thermal annealing of the Cr/4H-SiC interface up to 600 ^{o}C, the SBH value remained stable: 1.20 ±0.10 eV. The same behavior of stable SBH for the consecutive annealing steps has been observed in C-V measurements although the value was higher (1.4 eV). Nevertheless, the process of the annealings resulted in the improvement of the forward I-V characteristics of the Schottky diodes. Note that there was a discrepancy of about 0.3 eV between the barrier height extracted from I-V plot and the barrier height extracted from C-V. The SBH extracted from I-V is progressively decreasing after sub-sequent annealings. The ideality factor is decreasing as the temperature of the thermal annealing increased close to the value of 1.09, whereas the reverse leakage current is increased (one order of magnitude) after the annealings.

ABSTRACT: P I.61

Fano effect in quasi-one-dimensional wires with short- and finite-range impurities

Vassilios Vargiamidis, Philomela Komninou, and Hariton M. Polatoglou

Department of Physics, Aristotle University, GR-54124 Thessaloniki, Greece

Resonances in phase coherent electronic transport through mesoscopic systems are of great interest both as a basis for the creation of new resonant nanoelectronic devices and for revealing a fundamental aspect of quantum mechanics. Resonances of the Fano type have been treated theoretically in various condensed matter systems including transport through quasi-one-dimensional (Q1D) systems (such as wires and rings) with attractive impurities or embedded quantum dots. In this case, one often encounters points of vanishing transmission or reflection as the resonance is crossed. This is a result of the interference of two transport pathways, a resonant and a nonresonant one. Even though Fano resonances in Q1D wires occur regardless the type of impurity, the interference effects depend critically on the size and strength of the impurity. Using a coupled-channel theory that starts from the full scattering Hamiltonian, we analyze the effects of the strength of both short- and finite-range attractive impurities on the Fano resonance in a uniform quantum wire. Both types of impurity are taken to be arbitrary functions of the lateral coordinates. However, the short-range (SR) impurity is modeled by the Dirac δ function along the propagation direction while the finite-range impurity is modeled by a Pöschl-Teller (PT) potential (which is similar in shape to a Gaussian) that has a decay length α^{-1} along the propagation direction. It is shown that increasing the strength of a SR impurity causes a linear increase of the (Fano) asymmetry parameter and a monotonic decrease of the resonance width. On the other hand, increasing the strength of a PT impurity causes a transformation of an asymmetric Fano resonance first into a symmetric Breit-Wigner dip and subsequently into an "inverted" Fano resonance. This is reflected in an oscillatory behavior of both the asymmetry parameter and the resonance width. The temperature dependence of the Fano effect is also considered.

ABSTRACT: P I.62

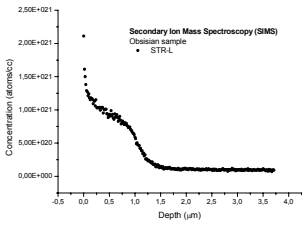
Comparison between SIMS and NRA for obsidian hydration dating purposes

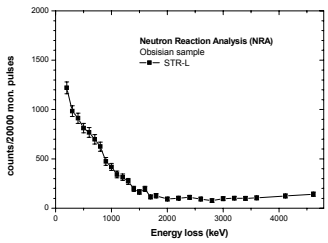
D. Grambole[1], W. Pilz[1], Th. Ganetsos[2], I. Liritzis[3] and N. Laskaris[3]

[1] Research Center Rossendorf Inc, Instit. of Ion Beam Physics & Materials Research, P.O. Box 510119, D-01314, Dresden, Germany, [2] Depart. of Electronics, Technological Educational Instit. of Lamia, 3rd Km O.N.R. Lamia-Athens, TK 35100, Greece, ganetsos@teilam.gr, [3] Lab. of Archaeometry, Univ. of Aegean, Dept. of Mediterranean Studies, 1 Demokratias Ave., Rhodes 85100, Greece, liritzis@rhodes.aegean.gr, n.laskaris@ieee.org

Two non destructive, non-invasive, rapid and sensitive analytical methods enable to answer one major issue in the field of Art and Archaeology, that one of dating.

Nuclear Reaction Analysis of Hydrogen with the ^{15}N-method can be used for the determination of the concentration of hydrogen nuclei (protons) in solid samples (obsidians). For fixed beam energy the resonance energy is reached in a certain well defined depth and nuclear reactions between the N^{15}-ions and the protons present in the region take place. (data obtained at F.Z.Rossendorf, Germany). Conversion of energy to depth is made through appropriate calculations.





SIMS profiles were taken by a PHI Model 6300 and 6600 quadrupole-based SIMS (data obtained at Evans East, USA). A 5.0 KeV Cs^+ primary ion beam with an impact angle of 60° with respect to the surface normal was used and negative secondary ions were detected. For flat and smooth areas reproducible errors in depth are 2-3%. Conversion of ion counts to concentrations is done using an ion implanted obsidian sample.

We will discuss the comparison of the measured profiles, their hydration depths, the resolution problems, and we will present some dating results, applying appropriate software programme.

References

1) E. Ioannidou, D. Bourgarit, T. Calligaro, J. -C. Dran, M. Dubus, J. Salomon and P. Walter, Nuclear Instruments and Methods in Physics Research Section B, Volume 161-163 , March 2000, Pages 730-736

2) Eric C. Faulques, Dale L. Perry and Andrei V. Yereme, Th. Calligaro, Spectroscopy of Emerging Materials , Probing Works of Art with Photons and Charged Particles, SPRINGER,2006

3) E. Drakaki, A.G. Karydas, B. Klinkenberg, M. Kokkoris, A.A. Serafetinides, E. Stavrou, R. Vlastou and C. Zarkadas, Appl. Phys. A, volume 79, 2004, pages 1111-1115

4) I. Liritzis, Archaeometry, Volume 48, Issue 3, August 2006, p.533-536

5) I. Liritzis, Th. Ganetsos, N. Laskaris, Mediterranean Archaeology & Archaeometry, vol.5,No2, pp75-91

ABSTRACT: P I.63

Nano- and micro- scale resolution in ancient Obsidian artefact surfaces: The impact of AFM on the obsidian hydration dating by SIMS-SS

I. Liritzis[1], N.Laskaris[1] and M. Bonini[2]

[1]. Laboratory of Archaeometry, University of the Aegean, 1 Demokratias Ave., Rhodes 85100, Greece (liritzis@rhodes.aegean.gr)
[2]. CSGI, Dept. of Chemistry, Room # 18, via della Lastruccia, 3, 50019 Sesto Fiorentino (FI), Italy

Obsidian artefacts used by prehistoric people could be dated by the secondary ion mass spectrometry by surface saturation (SIMS-SS) method. However, the method contains some limitations regarding the degree of smoothness of the surface. The presence of wells, cracks, pits, crystals and/or crests induce errors in the dating. Here, we briefly introduce the SIMS-SS method and provide first images of the Atomic Force Microsopy (AFM) of obsidian surfaces and discuss the impact of AFM results on the SIMS-SS dating. The presented dating is straightforward for flat regular surfaces and problematic for irregular surfaces.
In fact, The H_2O concentration versus depth profiles are modeled, following Fick's law of diffusion, which together with the concept of the surface saturation (SS) layer in obsidians both provide a sound basis for the new diffusion age equation (SIMS-SS) and are supported by dated world examples. It is known that depth resolution is limited by atomic mixing effects and the flatness of the analyzed area, and the dynamic range of depth profiles is limited by crater edge effects, neutral beam effects and several types of instrumental background.
As SIMS profiles are taken with a 300x300 μm ion beam raster, large enough to include narrower topological anomalies, the acquisition of SIMS H+ profiles contains all abovementioned causes for a distorted profile, resulted to problematic ages. Here we present a detailed surface investigation with AFM of 2D and 3D images of a dozen of selected prehistoric obsidian tools from archaeological sites. AFM imaging was performed with an Explorer TMX 2000 microscope (Topometrix). Details in the nano- and – micro-scale were observed on the surface. However, there are some areas free of crystals, voids and cracks, and these regions are ideal for SIMS. The effects of surface anomalies and/ or removed flakes on the SIMS-SS dating is apparent in the age calculations

ABSTRACT: P I.64

In-situ ellipsometric study of Ge^+ ion implanted SiO_2 layers under conditions of rapid thermal annealing

V.A. Shvets, I.E. Tyschenko, S.I. Chikichev, & V.Yu. Prokopiev

Institute of Semiconductor Physics, Russian Academy of Science, Novosibirsk, 630090, Russia, e-mail: tys@isp.nsc.ru

The properties of the Ge^+ ion-implanted SiO_2 films have received much attention in scientific publications. This interest is caused by a number of effects that have been observed in recent years and have opened up fresh opportunities for applications in the fabrication of opto- and nanoelectronic compatible with the current silicon technology. For future optical applications is very important to study the effect of respective structural objects formed under conditions of thermal treatments on the fundamental optical parameters of silicon dioxide matrix. In this paper, optical properties of the Ge^+ ion implanted SiO_2 layers have been investigated by real-time ellipsometric method during rapid thermal annealing. The behavior of Ge implanted silicon dioxide layers during heating at T_a = 500-1000 °C was studied by fast single-wavelength ellipsometry. Thermally grown 100 nm SiO_2 films on Si substrate implanted by Ge^+ ions with energy 75 KeV up to dose $1.5 \cdot 10^{16}$ cm^{-2} were used. A fast drop of ellipsometric parameters was obtained within the temperature range 500-650°C. The effect above is connected with the recombination of radiation defects (like E′ centers) produced by Ge^+ ion bombardment in silicon dioxide matrix resulted in the formation of ≡Si-Si≡, ≡Si-Ge≡ and ≡Ge-Ge≡ bonds in the SiO_2 network. As the defects recombination was completed, further increase in the temperature to 950°C resulted in subsequent change of ellipsometric parameters toward smaller extinction coefficient. This process may be associated with the formation of amorphous Ge nanoclusters as result of coalescence of germanium atoms. A turning point in ellipsometric trajectory was obtained as the annealing temperature achieved 950 °C. Under this condition, the extinction coefficient k decreased while the refractive index n was slightly increasing. This is attributed to the quantum-size effects within the formed Ge nanocrystals. No evidence of melting Ge phase was obtained.

ABSTRACT: P I.65

Assembly and electrical investigation of tiopronin- and citrate-stabilized Au nanoparticle chains between electrodes on patterned oxidized Si substrates under the influence of an electric field

A Zoy and A G Nassiopoulou*

IMEL/NCSR Demokritos, P. O. Box 60 228, 153 10 Aghia Paraskevi, Athens-Greece, www.imel.demokritos.gr
* e-mail: A.Nassiopoulou@imel.demokritos.gr

Tiopronin or citrate stabilized colloid Au nanoparticles have been assembled between microelectrodes on oxidized Si surfaces under the influence of electric field and the techniques of dielectrophoresis. On V-groove-etched lines between the electrodes the Au colloids formed single nanoparticle chains between the electrodes, while on non-patterned surfaces they formed randomly distributed nanoparticle assemblies. The samples were characterized by electrical measurements. We have investigated the temperature dependence of the conductance of the nanoparticle chains or assemblies between the electrodes. We found that the tiopronin-linked Au nanoparticle chains with an average diameter of 5 nm exhibited nearest-neighbour hopping conductivity in the order of 10^{-23} Ω^{-1} cm^{-1} with an activation energy of 0.137 eV. On the contrary, the structures of citrate-stabilized Au nanoparticles with an average diameter of 40 nm exhibited ohmic conductivity with a resistivity in the range of few Ω to few kΩ, depending on the configuration of the Au nanoparticles in the structure. The tunable conductivity of Au nanoparticle structures using different molecular linkers is very interesting and can be applied to sensor devices.

ABSTRACT: P I.66

TEM characterization of ultra-thin nanocrystalline Si films grown on quartz and presenting quantum properties

Ch.B. Lioutas[1], N. Vouroutzis[1], I. Tsiaoussis[1], N. Frangis[1] and A.G. Nassiopoulou[2]

[1]Solid State Physics Section, Department of Physics, Aristotle University of Thessaloniki, GR-54124 Thessaloniki, Greece, e-mail: lioutas@physics.auth.gr
[2]IMEL/NCSR Demokritos, P.O. Box 60228, Aghia Paraskevi, Athens 15310, Greece

Discrete electronic energy levels in valence and conduction band and a size depended band gap opening are the characteristics of semiconductor nanocrystals of sizes below few nanometers. These quantum effects in Si nanocrystals make them interesting for many nanoelectronic, photonic and sensor applications and are in general identified in isolated nanocrystals embedded in a dielectric. In a recent work [1], using spectroscopic ellipsometry measurements we showed that ultra-thin nanocrystalline silicon films (thickness ~ 5 nm and below), grown by low pressure chemical vapor deposition (LPCVD) on quartz, show clear evidence of discrete electronic states in band structure attributed to silicon nanocrystals of diameter below ~5 nm. Detailed structural characterization of such films with nominal thicknesses from 5 to 30 nm is made in this work, performed by transmission electron microscopy. Observations on plane view specimens showed that the distribution of nanocrystal size parallel to the Si/SiO_2 interface presents a well-defined maximum in all the films. The mean lateral size of the nanocrystals did not change very much with the film thickness, being in the area between 11-13 nm. The number of grains with size larger than the mean one tended to increase with the thickness of the film. Observations on cross-sectional specimens revealed that the films had a columnar growth, i.e. the third dimension of the nanocrystals, perpendicular to the Si/SiO_2 interface, was approximately equal to the film thickness, while the lateral size of nanocrystals was defined during the initial step of the growth, and was not very much affected by the film thickness. The nanocrystals size tended to increase during growth mainly in the growth direction, yielding to the columnar structure of the films.

[1] Ultrafast carrier dynamics in thin nanocrystalline silicon films on quartz, E. Lioudakis, A. Othonos, A. G. Nassiopoulou, Ch.B. Lioutas and N.Frangis, Submitted to APL (2007)

ABSTRACT: P I.67

Evolution of photoluminescence and chemical composition of the nanostructured silicon in water solutions

Viktoriya Shevchenko, Volodymyr Makara, Tetyana Veblaya & Vyacheslav Kravchenko

Faculty of Physics, Taras Shevchenko Kiev National University, Glushkov av., 2, Kiev, Ukraine, e-mail: shevchenko@univ.kiev.ua

Due to its biocompatibility, the nanostructured silicon is a promising material for applications in biology and medicine. Recently, many efforts have been made to study the possibility to use it as a substrate sensitive to biomolecular enviroment. It has also been suggested to use Si nanoparticles as fluorescence probes for biological applications. The above-mentioned applications are expected to be realized in water-based media and, therefore, there is a need to investigate the processes of formation of nanostructured silicon properties in water. This work reports a combined study of interaction of the nanostructured silicon with water solutions by means of IR spectroscopy and photoluminescence as a function of degree of pre-oxidation of the samples and of pH of the solutions.

The samples of nanostructured porous silicon were made on (100) wafers with resistivity of 10 Ohm*cm by means of electrochemical etching. Thereafter, they were partly oxidized in the air during a period of time from 1 hour to 3 months.

It is shown that at the first stage of interaction of nanostructured silicon with water there occurs mainly its dissolution with formation of silicic acid, at the second stage an oxide layer is formed at the nanostructured silicon surface. Its interaction with water is followed by increasing photoluminescence intensity and shifting the spectrum peak to higher energies, which is explained by decreasing sizes of nanocrystallites due to oxidation / dissolution of silicon. The properties of the samples are stabilized during a period of time from 2 hour to 3 days. The initial degree of oxidation of the samples oxidized in the air affects the time of stabilization of nanostructured silicon properties in water solutions, the thickness of oxide layer at the silicon nanostructure surface and parameters of photoluminescence of stabilized samples. The variation of the pH of water solutions from 4 to 8.5 influences mainly the rate of interaction of the nanostructured silicon with water and does not affect the chemical composition and photoluminescence of stabilized samples.

So, the obtained results show that it is possible to control the photoluminescent properties of nanostructured silicon in water solutions.

ABSTRACT: P I.68

A comparative study on the properties and structure of thermal annealed silicon-rich-oxide using different analysis techniques available within the European project ANNA (No.026134)

Mario Barozzi, Pierluigi Bellutti, M. Bersani, A. Picciotto, Georg Pucker, Lia Vanzetti

Istituto per la Ricerca Technologica e Scientifica – Fondazione Bruno Kessler, Via Sommarive 18, 38050 Povo-Trento, Italy, e-mail: pucker@itc.it

Silicon nanocrystals (Si-nc) embedded in SiO_2 are a complex material applied or studied in micro-electronics and opto-electronics for different devices such as nanocrystal memories, light emitting diodes, optical waveguides or optical amplifiers. A variety of methods can be used for the deposition and growth of nc-Si containing SiO_2 such as chemical vapour deposition, ion implantation, reactive magnetron co-sputtering and others. Generally the formation of Si-nc is obtained after material deposition by a high temperature thermal annealing. In this work we report on the preparation and structural analysis of Silicon nanocrystals (Si-nc) embedded in SiO_2 obtained by the thermal annealing of silicon-rich oxide deposited by plasma enhanced chemical vapour deposition. Samples with different ratios of precursor gases SiH_4 to N_2O were deposited with layer thickness of approximately 50 nm. In addition, in some samples NH_3 was added as nitrogen source during the deposition. Si-nc growth was obtained with thermal annealing at 1050°C. The samples were studied using variable angle spectroscopic ellipsometry (VASE), secondary ion mass spectrometry (SIMS), and x-ray photoelectron spectrocopy (XPS). SIMS depth profiles show a constant Si-concentration through the samples except a few nanometre wide regions at the Si_3N_4 and c-Si interfaces were Si-depletion occurs. We find excellent agreement between the sample thickness obtained from both SIMS and VASE analysis. While the effect of NH_3 addition during deposition is observed in the optical properties of the samples, it can not easily be correlated with structural changes in the samples. XPS analysis was used to estimate the percentage of O, N, and Si, and to study the nitrogen and Si bonding in the samples. NH_3 addition results in a reduction of the amount of silicon in a-Si or nc-Si nanoclusters and causes a delay of the crystallisation process.

ABSTRACT: P I.69

Advanced analytics of nanolayers and nanostructures using X-ray fluorescence methods

M. Kolbe, B. Beckhoff*, P. Hönicke, M. Müller, B. Pollakowski, and G. Ulm

Physikalisch-Technische Bundesanstalt (PTB), Abbestraße 2-12, 10587 Berlin, Germany
*email: burkhard.beckhoff@ptb.de

X-ray fluorescence analysis (XRF) is a non-destructive method that can contribute to the solution of a variety of nanoanalytical problems. Besides the investigation of both the composition and the thickness of layers in the nanometer range using conventional XRF, further applications can be obtained by varying the excitation parameters. Decreasing the incident angle below the critical angle of total reflection, TXRF allows for effective surface contamination analysis. Using monochromatized synchrotron radiation, the analytical capabilities are even more enhanced due to an appropriate incident photon energy chosen for the specific analytical problem. In addition, the tunability of synchrotron radiation allows different XRF techniques to be combined with NEXAFS investigations to determine the chemical state of nanolayer constituents as well as of contaminants.
PTB operates its own laboratory at the electron storage ring BESSY II in Berlin in which X-ray fluorescence methods can be performed using dedicated instrumentation at different beamlines. For investigations in the low Z elemental range, energies in the soft X-ray range (up to the Si-K-edge) are obtained by a plane grating monochromator at an undulator beamline. For measurements in the hard X-ray range, e.g. for investigations of transition metals, a four crystal monochromator beamline using synchrotron radiation from a bending magnet is available. Both beamlines can be equipped with different experimental set-ups for (T)XRF as well as X-ray reflectometry (XRR) measurements. For wafer analysis in the soft X-ray energy region, PTB has developed special instrumentation to handle silicon wafers with a diameter of 200 mm or 300 mm in cleanroom facilities fulfilling the requirements of the semiconductor industry.
The ongoing development of XRF analytical methods and appropriated instrumentation by the PTB is especially dedicated to investigations in the R&D of semiconductor samples related to industrial applications. Currently PTB is seeking to further extend its analytical capabilities to determine elemental depth profiling on structured wafers with respect to sidewall layers. For this purpose PTB's instrumentation for silicon wafers is being used to combine both TXRF and grazing incidence (GI)XRF analysis with XRR. Variously dense 3-dimensional trench structures on a 200 mm silicon wafer surface have been investigated. They contain nearly orthogonal silicon-nitride sidewalls, which were excited in order to reveal information about sidewall contamination, composition as well as chemical speciation.

ABSTRACT: P I.70

Temperature dependent EXAFS of InN

M. Katsikini[1], F. Pinakidou[1], E. C. Paloura[1], Ph. Komninou[1], A. Georgakilas[2,3], E. Welter[4].

[1] School of Physics, Aristotle University of Thessaloniki, 54124 Thessaloniki, Greece.
[2]Physics Dept., University of Crete, 71003 Heraklion-Crete, Greece
[3] Microelectronics Research Group, IESL-FORTH, 71110 Heraklion-Crete, Greece
[4] HASYLAB, Notkestr. 85, 22603 Hamburg, Germany.
e-mail: paloura@auth.gr

The mean square relative displacement of the atoms bonded to In in a 1.2 m - thick InN epilayer are studied using In *K* edge EXAFS measurements, in the temperature range 80 – 280K. The spectra were recorded at the C beamline of the Synchrotron Radiation Facility HASYLAB in Hamburg using a 7 – element fluorescence detector. The spectra are analyzed in the two following ways: (a) shell – by – shell fitting provides the temperature dependence of the Debye – Waller factors of the In – In shell. Application of the Einstein model provides the Einstein temperature of the In – In interaction. It is found equal to 190K, which is much smaller that the Ga – Ga Einstein temperature which was found equal to 300K in GaN samples. (b) From he simulation of the EXAFS spectra using the FEFF program and the equation of motion method for the determination of the Debye – Waller factors, we determine the force constants for the interaction of the In with its nearest neighbors. Various models for the accommodation of the thermal stress in the bonding environment of In, imposed by the different thermal expansion coefficients of the GaN epilayer and the substrate are discussed.

Acknowledgment: This work was supported by the EC under the contract MRTN-CT-2004-005583 (PARSEM).

ABSTRACT: P I.71

Photomodulated Thermoreflectance Microscopy on Ion Implanted Semiconducting Materials

Christiana Sherifi , Maria D. Papademetriou, Marios Nestoros and Constantinos Christofides

Department of Physics, University of Cyprus, 1678 Nicosia, Cyprus

The purpose of this work is to introduce an improvement to the already established Photomodulated Thermoreflectance technique. We present an extensive description of the new instrument, the function of which is verified by performing measurements on implanted annealed and non annealed phosphorous implanted silicon wafers. Thus, we prove the liability of the new instrument and, in addition, present, interpret and point out fundamental differences that arise between previous measurements. Several experimental measurements have been performed as a function of light modulation frequency between 1 and 1000 kHz. The measurements have also been performed in the presence of an external electric field. The influence of this field has also been extensively discussed.

ABSTRACT: P I.72

Structural study of ultra thin anodic silicon layers for nanoelectronic and photonic applications

Spiros Gardelis[1], Fotini Petraki[2,3] , Stylliani Kennou[2,3], and Androula G. Nassiopoulou[1]

[1]IMEL/NCSR Demokritos, P.O. Box 60228, Aghia Paraskevi, 15310 Athens, Greece ...
[2] Department of Chemical Engineering, University of Patras, 26500 Patras, Greece
[3]ICEHT/FORTH 26500 Patras, Greece

Silicon nanocrystals embedded in dielectrics are interesting for applications in nanoelectronics, photonics and sensor devices due to their particular transport and optical properties. Here, we study the growth of silicon nanocrystals with sizes ranging from 2 to 10 nm on silicon substrates, suitable for non-volatile and light-emitting devices, using a simple and cheap method based on anodic dissolution of bulk crystalline silicon with short monopulses of current. This method produces generally porous silicon layers, i.e. silicon nanostructures with voids in between, the size of which depends on the anodization conditions, mainly the electrolyte concentration, the anodization current density and the resistivity of the silicon substrate. We used different current densities and concentrations of the hydrofluoric acid electrolyte and applied short monopulses of anodization current in order to achieve the growth of ultra thin layers containing silicon nanocrystals with the desirable size. Atomic Force Microscopy (AFM) was used to investigate the surface of the layers. We also investigated the interface of the layers with the silicon substrate by removing chemically the layer from the substrate. X-Ray Photoelectron Spectroscopy (XPS) was used to investigate the chemical composition of the surface of porous structure. It was found that the structure of the produced layers was very different between high and low HF concentration electrolytic solutions. In high HF concentrations the produced films in the transition regime between porosification and electropolishing were highly porous, amorphous or dust – like, while at low HF concentration under the same other conditions, the produced structures were granular, with nanometer size grains on the sample surface. From XPS it was found that in this second case the samples were oxidized at their surface under ambient conditions, forming a native silicon oxide (SiO_2) like in bulk Si, which was easily removed by a mild sputtering. In samples fabricated at high HF concentration, the film structure was porous and silicon sub-oxides were detected in their volume, which were not removed by argon sputtering of the surface.

ABSTRACT: P I.73

A Comparative Evaluation of De-Embedding Methods for on-wafer RF CMOS Inductor S-parameter Measurements

Maria Drakaki[1], Alkis A. Hatzopoulos[2], & Stylianos Siskos[3]

[1]Department of Electronics, Alexander Technological Educational Institute of Thessaloniki, Thessaloniki, Greece, e-mail: drakaki@el.teithe.gr
[2]Faculty of Department of Electrical and Computer Engineering, Aristotle University of Thessaloniki, Thessaloniki, Greece, e-mail: alkis@vergina.eng.auth.gr
[3]Faculty of Department of Physics, Electronics Laboratory, Aristotle University of Thessaloniki, Thessaloniki, Greece, e-mail: siskos@physics.auth.gr

The impact of existing de-embedding methods applied on RF CMOS on-wafer S-parameter measurements to evaluate the characteristics of integrated inductors is examined. Probe pad and metal interconnect line associated parasitic elements need to be removed (de-embedded) from on-wafer measurements of inductors fabricated on silicon substrates for proper evaluation of inductor characteristics, such as inductance, quality factor and resonance frequency. For this purpose a chip was fabricated in 0.5 um CMOS TM1P twin-tub AMIS technology (Figure 1), with octagonal and spiral inductors and various types of dummy structures, such as different types of open, and short structures as well as a thru structure. The dummy structures are necessary in order to extract the parasitic element components. The Device-under-Test (DUT) was a 3.5 turn octagonal inductor of line width 12 μm, spacing 2 μm and external diameter of 160 μm. Existing de-embedding methods include the open-short de-embedding method [1], a three-step de-embedding method [2], and a pads-short-open (psod) de-embedding method [3]. These methods have been tested mostly for small devices such as MOS transistors. The impact of each de-embedding method on inductor characteristics extraction is evaluated and results show differences in the order of 7% for the value of peak inductance, and a variation of 1.1 GHz for the resonance frequency. The comparative evaluation of the existing de-embedding methods is based on comparison of simulated and measured S-parameter data for measurements up to 20 GHz. Based on the results suggestions are made for improving the accuracy of the de-embedding for a precise characterization of the DUT.

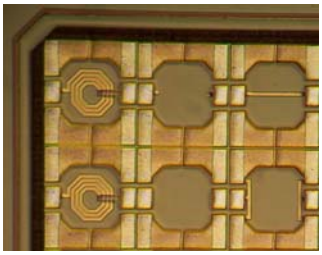


Figure 1. Microphotograph of part of the fabricated chip showing the DUT and dedicated dummy structures.

[1] L. F. Tiemeijer and R. J. Havens, "A calibrated lumped-element de-embedding technique for on-wafer characterization of high-quality inductors and high-speed transistors," *IEEE Trans. Electron Devices*, vol. 50, no. 3, pp. 822-829, Mar. 2003.
[2] H. Cho and D. E. Burk, "A three-step method for the de-embedding of high-frequency s-parameter measurements," *IEEE Trans. Electron Devices*, vol. 38, no. 6, pp. 1371-1375, Jun. 1991.
[3] R. Torres-Torres, R. Murphy-Arteaga, and J. Apolinar Reynoso-Hernandez, "Analytical Model and Parameter Extraction to Account for the Pad Parasitics in RF-CMOS" *IEEE Trans. Electron Devices*, vol. 52, no. 7, pp. 1335-1342, Jul. 2005.

ABSTRACT: P I.74

Simulation of the electrical characteristics of MOS capacitors on strained-Silicon substrates

N. Kelaidis, D. Skarlatos & C. Tsamis

NCSR "Demokritos", Institute of Microelectronics, 15310, Aghia Paraskevi, Athens, Greece
e-mail: ctsamis@imel.demokritos.gr

There has been a great gain of momentum in the development of composite substrates in semiconductor technology, as a way of increasing device performance without further decrease of the device dimensions. Strained-Silicon on relaxed $Si_{1-x}Ge_x$ has proven a very important material due to the beneficial effect of strain on the mobility of carriers in these substrates. The conventional method of dry, high-temperature oxidation on bulk-Si produces high quality oxides but, in the case of strained-Silicon, has to be carefully implemented, avoiding high thermal budgets which degrade performance via potential strain relaxation and Germanium diffusion. Electrical characterization of MOS capacitors on strained-Silicon substrates is a valuable tool for examining the material properties after oxidation, such as oxide charge, interface charge and leakage current.
In this work, we analyze the electrical characteristics of MOS capacitors fabricated on strained silicon substrates, using the commercial software Taurus/Synopsis. The effect of various parameters such as Germanium concentration in the $Si_{1-x}Ge_x$ virtual substrate, thickness of the strained-Silicon layer, oxide thickness, fixed charge and interface trapped charge, on capacitance – voltage and current – voltage characteristics is examined. Simulation results are compared with experimental data on Al-gate MOS capacitors fabricated on strained-Silicon substrates of two different strain-levels, oxidized at various conditions. A strong influence of the s-Si / SiGe heterostructure and its proximity to the s-Si/SiO_2 on the electrical characteristics of this system was found. Simulation predicts the influence of the strained-Si thickness remained after oxidation, i.e. a characteristic hump on the C-V curves attributed to bandgap discontinuity phenomena, which varies with oxidation conditions. Oxide charge calculated for the experimental data via simulation shows an increase of charge with decreasing s-Si thickness, in agreement with literature. The effects of oxide tunneling and of interface trapped charge are also analyzed.

The present work has been co-funded by European Community funds and by National funds (E.P.E.A.E.K.), under the 'Archimides' programme

POSTER SESSION 2:

DEVICES, SENSORS & MICROFLUIDICS

ABSTRACT: P II.1

Compact Current Modeling of Short-Channel Multiple Gate MOSFETs

Sigbjørn Kolberg, Håkon Børli and Tor A. Fjeldly

UniK – Univ. Graduate Center, Norwegian Univ. of Science and Technology, Instituttveien 25, 2027 Kjeller, Norway

We present a 2D physics based compact model of the double gate (DG) and the gate-all-around (GAA) MOSFET, with emphasis on short-channel devices of nanoscale dimensions. A framework model of the drift diffusion current modeling in these devices has been presented in refs. [1-3].
In compact modeling of the drain current, the main concern compared to the physics based framework is to find analytical expressions for the I-V characteristics, which are compatible with the efficiency requirements of circuit simulators. We use a set of generic, semiempirical expressions for the I-V characteristics with parameters that are extracted to any desired accuracy from the modeling framework. This model is based on explicit subthreshold and strong-inversion limits that are readily available from the modeling framework, and on the bias dependences of the drain current near threshold expressed in terms of parameters that are extractable from the framework.
For sub-threshold conditions, we assume that the device body is dominated by the solution of the 2D Laplace electrostatics. This assumption is based on the fact that the field strength at the gates emerging from the mobile charge carriers and the doping are much weaker than the fields related to the capacitive coupling between the contacts and the gates. Therefore, we neglect the body charge term in Poisson's equation, converting it to a Laplace equation. This assumption has been verified by numerical simulations for the devices considered.
Near threshold, the influence of the electronic charge on the electrostatics is taken into account in the framework model in a precise, self-consistent manner by combining suitable model expressions with the 2D Poisson's equation in the device body. Therefore, a self-consistent treatment that takes into account both the mobile charge and the capacitive coupling has to be introduced for this regime. To this end, we consider the self-consistent potential distributions along the two symmetry axis. Suitable modeling expressions are applied, whose parameters are determined from the boundary conditions and by enforcing consistency using Poisson's equation.

References:

[1] S. Kolberg, T. A. Fjeldly, and B. Iñiguez, "Self-Consistent 2D Compact Model for Nanoscale Double Gate MOSFETs ", *Lecture Notes in Comp. Science,* Springer, Berlin, Vol. 3994, pp. 607-614, 2006.
[2] H. Børli, S. Kolberg, and T. A. Fjeldly, "Compact Modeling Framework for Short-Channel DG and GAA MOSFETs " (invited paper), NSTI Nanotech 2007, Workshop on Compact Modeling, Santa Clara, CA, May 20-24, 2007, 2007, vol.3, pp. 505-509.
[3] S. Kolberg, H. Børli, and T. A. Fjeldly, "Modeling, Verification and Comparison of Short-Channel Double Gate and Gate-All-Around MOSFETs", accepted, *J. Math. and Comp. in Simulations*.

ABSTRACT: P II.2

MACROPOROUS SILICON AS BOTTOM ELECTRODE IN A HIGH CAPACITANCE SILICON MICROCAPACITOR

A. Sancho, F.J. Gracia

CEIT and TECNUN, University of Navarra (CEIT), Paseo de Manuel Lardizabal, 15, San Sebastián 20018, Spain

The goal of this research is to develop silicon macroporous structures to be used as the bottom electrode for a high-capacitance silicon integrated microcapacitor. Considering a parallel plate capacitor, its capacitance can be improved by enlarging the surface area of the electrodes, using high-k dielectric material and reducing the distance between the electrodes. In this work, High Aspect Ratio Structures (HARS) have been developed by means of electrochemistry to ensure enlargement of the surface area. This effect provides an increase in the final capacitance, which is proportional to a plate capacitor, multiplied by the resulting geometric factor.
Macroporous silicon, unlike mesoporous and microporous, is a HARS, whose depth, diameter and even location of the macropores can be customized. Starting from a <100> P type silicon substrate, vertical macropores of a 10-100 aspect ratio have been developed. The structures have been characterized by Scanning Electron Microscopy (SEM). The variation of the pore density and the growth rate in relation with the applied anodization current density has been modeled.
Vertical macropores have been grown in N type silicon substrates too. Together with the <100> crystalline orientation, in this case a homogenous back side illumination is also required, due to the tendency of the macropores to grow towards the source of electronic holes. For this reason, the material deposited on the back side of the wafer as the electric contact, not only needs to be highly conductive, but also highly light-transmitting. The

Indium Tin Oxide (ITO) is an appropriate material for this purpose. The deposition parameters of the Physical Vapor Deposition (PVD) and the subsequent thermal treatment have been optimized. The resulting high transmittance and low sheet resistance have been tested and demonstrated by spectrometry, X-ray Diffraction (XRD) and a Sheet Resistance Monitoring System.
The macroporous structures have been doped with phosphorous to provide a sheet resistance as low as 3 ohm/sq in the bottom electrode. Next, a silicon oxide layer has been thermally grown to be used as the dielectric material of the capacitor. Finally, the top electrode, consisting of a polysilicon film, has been deposited by the Low Pressure Chemical Vapor Deposition (LPCVD) technique, prior to a phosphorous doping process. The perfectly conformal deposition provided by the LPCVD technique has been demonstrated by Field Emission Gun SEM (FEGSEM).

ABSTRACT: P II.3

GAS MANAGEMENT TROUGH MACROPOROUS - MESOPOROUS SILICON BILAYERS

S. Desplobain[1,2], G. Gautier[1], L.Ventura[1] and M. Roy[2]

[1] Université de Tours Laboratoire de Microélectronique de Puissance, LMP, 16 rue Pierre et Marie Curie, BP 7155, 37071 Tours France, [2] STMicroelectronics, 16 rue Pierre et Marie Curie, BP 7155, 37071 Tours France

Since its discovery in 1956, porous silicon has found many applications such as integrated gas sensors [1] or biological fluid diffusion layers [2].
In this paper, we study gas management through porous silicon membranes. The structure is a combination of a macroporous layer surmounted by a mesoporous one.
In this work, we use N-type <100> silicon substrates with a resistivity of 26-33 Ω.cm. Then, two N^+ layers are realized with a phosphorous pre-deposition and an annealing at 1050°C during 8 hours on both sides of the wafer. The N^+/N junction depth is about 12µm. The anodization process is carried out in a 6 inches double-tank anodisation cell with a backside illumination using a $HF:CH_3COOH:H_2O$ mixture.
In a first step, we etch the mesoporous layer with a low current density until we reach the junction. Then, to perform the macroporous silicon etching, a higher current density is applied. At the end of the process, the mesoporous silicon layer formed on the wafer backside is removed. This process is performed using a dilute KOH solution or increasing drastically the anodisation current to reach the electropolishing regime.
Several morphologies, obtained with various current density couples, are studied. The average pore diameter observed in the mesoporous layer is about 8 nm. In the case of the macroporous layer, the morphology varies with the depth increase from 1 to 3 µm. The branching of these pores is also more significant beyond 100 µm depth.
The permeability measurements are performed with a specific test bench developed for membrane diameters from 1.5 to 6 inches. Then, we study the gas flow behavior according to the porosity and the thickness of the porous layers.

References:
[1] G. Barillaro,P. Bruschi, F. Pieri and L.M. Strambini., Stat. Sol. (a) 204, 1423 (2007).
[2] J. Wallner, N. Nagar, C. Fiedrich, P. Bergstrom, . Stat. Sol. (a) 204, 1327 (2007).

ABSTRACT: P II.4

Application of electrochemical impedance spectroscopy and equivalent circuit approach to the study of silicon DNA sensor

V.I.Ogurtsov*, M. Manning

Tyndall National Institute, Lee Maltings, Prospect Row, Cork, Ireland, vladimir.ogurtsov@tyndall.ie

Bioanalytical microsystems have considerable potential for application required specific, rapid and cost effective interrogation of genetic information in clinical diagnostics, detection of genetically modified foods, bioterrorism agents and monitoring of environmental pollutants etc. Most optical and electrochemical detection methodologies are indirect requiring either labeling of the target, the use of external indicators or signaling probes to confirm hybridization has occurred. Labeling in general is expensive, time and labor consuming and adds to the overall cost of any system. In recent years considerable interest has focused on the development of label independent sensing technologies. Electrochemical impedance spectroscopy (EIS) technique does not require labeling and is compatible with a wide variety of bio-applications thus explaining the outburst of practical interest in this particular methodology during the last decade. In this study, investigation of the silicon DNA sensor by impedance spectroscopy and equivalent circuit approach is discussed. The sensor is represented a Si/SiO2 substrate with a metal layer on the silicon side and a silane linker layer with attached DNA probe on the silicon oxide side.

Selection of this type of the sensor relates to its compatibility with modern micro- and nano- technologies, thus expanding the possibilities for developing biosensor-on-chip or entire Lab-On-A-Chip system with this biosensor included. The developed equivalent circuit is based on the physicochemical principles of the sensor work, it takes into account both the silicon bulk and sensor surface interface. Specification of equivalent circuit was performed by applying a nonlinear complex fitting procedure for the sensor complex impedance data. A clear frequency depended difference between impedance spectrums for each steps of surface chemistry was observed. Analysis of equivalent circuit parameters illustrates that these changes are mostly connected with variations of sensor double-layer capacitance and diffusion process on the sensor surface. The results obtained from this study are of particular importance in sensor optimization and instrumentation development.

ABSTRACT: P II.5

An Experimental Study of Band Gap States Electrical Properties in Poly-Si TFTs by the Analysis of the Transient Currents

Loukas Michalas[1], Georgios J. Papaioannou[1], Dimitrios N. Kouvatsos[2], Apostolos T. Voutsas[3]

[1]Solid State Section, Physics Department, National Kapodistrian University of Athens, Panepistimiopolis Zografos, 15784, Athens, Greece, lmichal@phys.uoa.gr, gpapaioan@phys.uoa.gr
[2]Institute of Microelectronics NCSR Demokritos Aghia Paraskevi, 15310, Athens, Greece, dimkouv@imel.demokritos.gr
[3]LCD Process Technology Laboratory Sharp Labs of America, 5700NW, Pacific Rim Blvd, Camas, Washington, USA, avoutsas@sharplabs.com

The presence of a large amount of electrically active defects in their active area is a major drawback of poly-silicon Thin Film Transistors. These states are responsible for the formation of potential barriers as well as for the control of carriers' generation-recombination mechanisms that determine the device performance. Therefore different models have been proposed to predict the electrical properties of these states.
From the experimental point of view, several methods have been employed based on the dispersion of AC (trans)conductance or the transient response of the drain current monitored after an electrical excitation. In both cases, the currents have been correlated to the trapping and emission of carriers in these states. Regarding the transient method the capture/emission of holes in the lower half of the band gap has been proposed as responsible for the rise of switch-ON overshoot transients, while recently the undershoot effect has been attributed to the capture/emission of electrons in states in the upper half of the band gap.
Aim of the present work is to present a simultaneous temperature analysis of transfer characteristics, the switch-ON overshoot and the "switch-OFF" undershoot effects in poly-silicon TFTs, in order to obtain experimentally, information on the electrical properties of states located across the band gap. Both overshoot and undershoot transients were found to obey the stretched exponential relaxation, due to the contribution of the continuous distribution of states. The time constant obtained from each process was found to be thermally activated, while the calculated activation energies denote the contribution of deeper states in the lower half of the band gap. Additional calculations allowed the estimation of the density of states. Conclusively, it is presented, that the analysis of the transient currents could act as a method for detailed characterization of poly-silicon material in TFTs.

ABSTRACT: P II.6

Optimization of DLC- Porous Silicon Antireflection Coating Proprieties for Multicrystalline Silicon Solar Cells

K. Ait Hamouda[1, 2], N. Gabouze[1], A. Ababou[2]

1. UDTS, 02 Bd. Frantz Fanon, B.P. 140 Sept Merveilles, Algiers, Algeria, 2. USTHB, B.P. 32 El Alia, Bab Ezzouar, Algiers, Algeria

In this work, we report on the application of Diamond-Like Carbon (DLC) as an antireflection coating material for multicrystalline Silicon solar cells.
First, porous silicon (PS) layer was formed by electrochemical process, and then DLC layer was deposited by PECVD method.
The optical proprieties of these layers were investigated in order to establish the optimum preparation conditions for solar cell applications. Reflectivity measurements, quantum efficiencies and I-V characteristics are presented and compared with the performances of cells using a PS antireflection coating only.
The effectiveness of DLC as an antireflection coating for multicrystalline solar cells with PS emitter is clearly demonstrated.

Keywords: Diamond-Like Carbon (DLC), Solar cells, Porous silicon (PS), Antireflection coatings

ABSTRACT: P II.7

Realization of a magnetic field sensor with a porous silicon based structure for gas detection

Y. Ouadah*, G. Fortas, N. Chiboub, H. Cheraga, N. Gabouze

UDTS, 02 Bd. Frantz Fanon, BP 140, Alger-7 merveilles 16200 Algerie, *ouadahy@udts.dz

The porous silicon (PS) based gas sensors are known for their advantages like good sensitivity to several gasses due to their large internal surface, reversibility, low cost, compactness and integration in silicon technologies. In this work, we design a PS based gas sensing device in which the magnetic parameter is introduced. Since the PS has a good electrical isolation, planar inductors are directly realized on the sensing device. The response for different gases (CO_2, H_2, O_2 etc.) has been investigated. The results show that the induced voltage varies with both concentration and nature of gas.

Keywords: porous silicon, gas sensor, induction

ABSTRACT: P II.8

Ideality factor dependence of leakage current and reverse current noise of Au/n-GaAs Schottky diodes with embedded self-assembled InAs quantum dots

N. Arpatzanis[1], C. A. Dimitriadis[1], C. Charitidis[2], J. D. Song[3], W. J. Choi[3] and J. I. Lee[3]

[1]Depart. of Physics, Aristotle Univ. of Thessaloniki , 54124, Greece, *narpatza@auth.gr*, [2]School of Chem. Engineer., Nat. Technical Univ. of Athens, 15780, Greece, [3] Nano Device Research Center, Korea Institute of Science and Technology, Seoul 136-791, Korea

The electrical properties of Schottky contacts on n-type GaAs with embedded InAs quantum dots (QDs) were studied by current-voltage (I-V) and low-frequency noise measurements. Diodes without containing QDs were investigated as reference devices. The level of the reverse current I_r as well as the reverse current noise spectral density are expected to be correlated with the ideality factor n, since both are impacted by the Schottky contact quality. To clarify the correlation of the ideality factor with the leakage current and noise level, Schottky diodes with a wide range of ideality factor values were investigated. The main features of the reverse I-V characteristics indicate that space-charge limited current (SCLC) dominates the carrier transport in these diodes, influenced by the presence of a deep trap level and a distribution of trapping states in the forbidden energy gap. To probe the properties of these traps in the GaAs capping layer, noise measurements were performed as a function of the reverse bias voltage. The reverse current noise spectra show 1/f behaviour, attributed to traps uniformly distributed in the forbidden energy gap of the GaAs capping layer. In the diodes containing QDs, in addition to the 1/f noise, a g-r noise was found originating from a discrete trap level. Depth profiling measurements of the 1/f and g-r noise power spectral densities were performed in diodes with different ideality factors to correlate the diode quality with the distribution of the above traps within the GaAs capping layer.

ABSTRACT: P II.9

Charge trapping phenomena in high-efficiency metal-oxide-silicon light-emitting diodes with Tb ion implanted oxide

Nazarov A.[1,3], Osiyuk I.[1,3], Tyagulskii I.[1], Lysenko V.[1], Prucnal S.[2], Sun J.[3], Yankov R.[3], Skorupa W.[3]

[1]Lashkaryov Institute of Semiconductor Physics, NASU, 41, pr. Nauky, 03028 Kiev, Ukraine (nazarov@lab15.kiev.ua), [2]Maria Curie – Sklodowska University, Pl. M. Curie –Sklodowska 1, 20-031 Lublin, Poland, [3]Institute of Ion Beam Physics and Materials Research, Forschungzentrum Rossendorf e.V., POB 510119, D-01314 Dresden, Germany

This work is a combined study of Tb implanted silicon dioxide layers in SiO_2-Si structures regarding to link of electroluminescence intensity (ELI) with clustering of rare-earth oxide complexes and charge trapping in these complexes and defects associated with the rare-earth light emitting complexes.
Ion implantation was performed in a wide dose range using doses chosen to provide impurity concentrations of 0.5 to 3 at. % with the implant profiles peaking in the middle of the oxide. To improvement of quality of the gate oxide a surface of the dielectric was subjected to plasma assisted nitridation. Post-implantation anneals were carried out at temperatures from 800 to 1100^0C. An ITO layer was employed as the transparent gate electrode.
Charge trapping was studied using an electron injection technique at constant current regime in the range of 10^{13} to 10^{21} e/cm^2 with simultaneous measurements of the ELI. High-frequency C/V characteristics were used to control the net charge in the oxides. The I/V and the ELI/V characteristics were also measured. Clustering was studied by cross-section transient electronic microscopy (TEM).
It was shown that increase of concentrations and size of rare-earth (RE) oxide clusters at rise in annealing temperature correlates with decrease of ELI and generation of negative charge traps with capture cross-section in the range from 10^{-16} to 10^{-18} cm^2. Because of RE atoms incorporation into oxide matrix results in generation of positively charged traps with distributed capture cross section from 10^{-15} to 10^{-18} cm^2, it was shown that an annealing conditions where charge trapping in the oxide is near zero and ELI is stable during long of time is possible to find. A study of electroluminescence (EL) quenching has shown that life time of the light emitting diode increases with increase of annealing temperature. The mechanisms of EL degradation of the Tb implanted SiO_2-Si structures are discused.

ABSTRACT: P II.10

Modified MIS-structure based on nanoporous silicon with enhanced sensitivity to hydrogen containing gases

T.I. Gorbanyuk*, A.A. Evtukh, V.G. Litovchenko, V.S. Solntsev

V.E. Lashkaryov Institute of Semiconductor Physics, National Academy of Science of Ukraine, Kiev 03028, Prospect Nauki 41, UKRAINE
*e-mail: tatyanagor@mail.ru

The catalytic-adsorption properties of the layered semiconductor structures metal - isolator-semiconductor (MIS) based on nanoporous silicon with Pd and bimetal Cu/Pd top metal electrodes have been studied and compared. The metal films were obtained by DC magnetron deposition in Ar plasma. Detailed investigations of surface morphology and chemical composition of the layers by means of SEM, AFM and AES depth profiling have been performed too. A shift of the flat band voltage (ΔV_{FB}), obtained from the measurements of capacitance-voltage characteristics was used as a response of a MIS structure on the supplying of gas pulses. Such gases as hydrogen, hydrogen sulphide, humidity and oxygen were tested by the sensors. The kinetics of the responses was studied experimentally and compared with the results of a computer simulation. To investigate the stability of the MIS-structures, they were subjected to an accelerated artificial ageing by annealing in air at 200-450 °C during 0.3-3 h. The selectivity to hydrogen sulphide in the humid ambient was achieved by using the thin polymer films.
It was found that MIS sensors with Cu/Pd composite layers based on nanoporous silicon demonstrate higher sensitivity to hydrogen sulphide gas and higher stability under artificial ageing that similar structures with Pd layer only. The physical model has been proposed for explanation of the observed phenomena.

ABSTRACT: P II.11

Spin-Transfer Torque in Double-Barrier Magnetic Tunnel Junctions

Ioannis Theodonis[1], Alan Kalitsov[2], Nicholas Kioussis[3]

[1]Department of Physics, National Technical University Athens, Zografou Campus 15780, Greece email: ytheod@mail.ntua.gr.
[2]Department of Physics, California State University Northridge, CA 91330-8268, USA.
[3]Theoretische Physik, Universität Kassel, Heinrich-Plett-Strasse 40, 34132 Kassel, Germany.

Double-barrier magnetic tunnel junctions (DBMTJ) consisting of a central magnetic layer between two insulating barriers and two ferromagnetic(FM) electrodes have attracted significant interest due to their potential applications in spintronics devices, such as magnetic sensors and magnetic random-access memories. The spin-transport properties in DBMTJ are determined by quantum well states (QWS) formed in the middle layer[1]. While the physics underlying the current-induced magnetization switching (CIMS) in non-collinear single-barrier MTJ have been extensively studied both theoretically and experimentally, its role in DBMTJ remains an unexplored area. A question of practical interest is, under what conditions quantum well states can enhance the spin-transfer torque responsible for the CIMS? Using tight-binding calculations and the non-equilibrium Keldysh formalism, we have studied for the first time the effect of the QWS on the components of the spin-transfer torque parallel, $T_{\square}$, and perpendicular, $T_{\square}$, to the interface, in DBMTJ. Interestingly our results reveal that both components of the local spin torque can be dramatically enhanced for values of the thickness of the middle layer, b, for which the spin-up and spin-down QWS are in close proximity to each other and lie within the bias energy window at the chemical potential of the leads. For symmetric DBMTJ we show that $T_{\square}$, which measures the non-equilibrium exchange coupling, deviates from the usual sinusoidal dependence on the angle θ between the magnetizations of the FM electrodes and the middle FM layer. The underlying origin of the non-sinusoidal angular dependence lies on the enhancement of the biquadratic exchange coupling[4], due to the proximity of the spin-up and spin-down QWS within the bias energy window. Under these conditions, the equilibrium magnetization configuration corresponds to the perpendicular alignment of the magnetizations of the left and right leads with respect to the magnetization of the middle FM region.

References:

[1]J.S. Moodera et al, Phys. Rev. Lett. 83 3029 (1999)
[2] E. Y. Tsymbal, O.N. Mryasov and P.R. LeClair J. Phys.:Condens. Matter 15 R109-R142 (2003)
[2] J.C. Slonczewski JMMM 150, 13-24 (1995)

ABSTRACT: P II.12

Current transport mechanisms for n-InSe/p-CdTe heterojunctions

P.N. Gorley[1], Z.M. Grushka[1], O.G. Grushka[1], O.A. Chervinsky[1],
P.P. Horley[1], Yu. V. Vorobiev[2], and J. González-Hernández[3]

[1]Yuri Fedkovych Chernivtsi National University, 58012 Chernivtsi, Ukraine
[2] CINVESTAV-IPN, Unidad Querétaro 76230, México. <vorobiev@qro.cinvestav.mx>
[3]CIMAV, Miguel de Cervantes 120, Chihuahua, México. <jesus.gonzalez@cimav.edu.mx>

Significant interest towards cheap and efficient technology to grow n-InSe/p-CdTe heterostructure (HJ) is caused by the possibility to find an efficient substitute to the traditional silicon-based photodiodes for the operation under the high radiation conditions. This paper presents the results of investigation of current-voltage curves (CVC) of this heterojunction, created by the deposition over the optical contact. The initial monocrystals of CdTe and InSe were grown by Bridgman method. Concentration and mobility of the holes in CdTe were $p\approx(1\div5)\cdot10^{14}cm^{-3}$ and $\square_p\approx(60\div80)$ $cm^2/(V\cdot s)$; for the electrons in InSe we had $n\approx(3\div7)\cdot10^{16}cm^{-3}$ and $\square_n\approx800\div950cm^2/(V\cdot s)$, respectively. Monocrystalline CdTe plates with the thickness 300-500 □m were used as the substrates. High quality of CdTe surface was achieved by mechanical and chemical polishing of the samples. Thin plates of InSe with the area of several square milimeters were obtained by mechanical chipping of the layers (about 10□m thick) from the monocrystalline ingot. The plates of InSe featured the naturally-perfect surface and did not require any further treatment. Electrical contacts for the both layers of HJ were made by the deposition of indium. CVC of the heterojunctions were measured for the temperatures 250-330K under the direct current and voltage *U* varying from 0.09 to 8V (forward bias) and 12V (reverse bias). The obtained CVC were of the diode type with the rectification coefficient 350÷400 for $U=\pm1$V under the room temperatures. Being illuminated with the high-intensive light, the maximum photovoltage value was 0.46V for 300K. Analysis of the results obtained has shown that the forward-biased CVC branches for n-InSe/p-CdTe heterojunctions can be satisfactorily explained in the framework of the recombination model of current transport. It is important that under the low values of the reverse voltage ($|U|<3$V), the main contribution to the current transport is made by the recombination processes in the space charge region.

ABSTRACT: P II.13

The Study of ESD Induced Defects in Grounded Gate NMOS Using Low Frequency Noise Measurements

J. Hadzi-Vukovic, M. Jevtic[1], M. Glavanovics[2], H. Rothleitner

Infineon, Siemensstrasse 2, 9500 Villach, Austria
Phone: + 43 4242 305 6675; Fax: +43 4242 305 6698; e-mail: Jovan.HadziVukovic@infineon.com
[1] Institute of Physics, Pregrevica 118,11080 Belgrade, Serbia
[2]Kompetenzzentrum Automobil und Industrieelektronik, Europastraße 8,
9524 Villach,Austria

To investigate the reliability of ESD protection, based on grounded gate NMOS transistor (GGNMOS) in smart power integrated circuits the ESD experiments are performed and degradation is analyzed by low frequency noise measurements on non-stressed and stressed devices. The goal of our investigation was to understand in detail the behavior of GGNMOS for lower ESD stress voltages applied once or several times. Input pins described in this paper consist of GGNMOS as first ESD protection and the combination of a polysilicon resistor and a zener diode as a second ESD protection.
Combining the noise results and those obtained by other failure analysis analytical methods we have examined a location and the nature of defects. To understand failures we performed an Emission Microscopy for Multi-layer inspection (EMMI), which revealed the spot at one corner of the GGNMOS. A Focused Ion Beam (FIB) cut shows the current induced damages - filamentation and/or junction spiking at the drain side. Special attention was dedicated to analysis of latent defects.
The g-r noise spectra measured after stress have correlated with activation of g-r centers in reverse biased p-n junctions at drain side of GGNMOS and in diode. Our experiments have shown that noise is more sensitive comparing to I-V curves: the same failure causes 1.4 % change of IV curves, but one order of magnitude difference in the low frequency noise region. Repetitive stresses are today very important and low frequency noise could be very useful screening and diagnostic tool in these cases also. Noise as reliability indicator for repetitive testing could be used and in high volume production. Presented method gives possibility of estimating the quality of ESD protection.

ABSTRACT: P II.14

READOUT INTEGRATED CIRCUIT FOR X-RAY IMAGING WITH CdTe PIXEL SENSORS

Charalambos Lambropoulos[1], Emmanouel Zervakis[1], Dimitris Loukas[2]

[1]Technological Educational Institute of Halkis, e-mail:lambrop@teihal.gr, zervakis@theon.gr
[2]Institute of Nuclear Physics, NCSR Demokritos, e-mail: loukas@inp.demokritos.gr

A small scale prototype of a readout integrated circuit appropriate for X-ray imaging working in charge integration mode has been designed. Each pixel consists of a capacitive transimpedance amplifier, a sample and hold circuit, a comparator and an 8 bit DRAM.
Pixel level A/D conversion and local storage of the digitized signal is performed.
Per –pixel A/D conversion has not been used for 2 dimensional arrays of X-ray imaging hybrid pixel sensors until now, although the space constraints are relaxed due to the fact that the sensing element is outside the readout integrated circuit. The advantages are: minimization of signal degradation due to cross talk, easier use of noise reduction techniques, local intelligence, thousands of frames per second.
The target sensors are 100um x 100um CdTe pixel detectors and integration time of 1ms or less can be achieved. Special measures have been taken to minimize the gain fixed pattern noise and the reset noise while purely digital correlation double sampling can be peformed.

ABSTRACT: P II.15

p-$SrCu_2O_2$/n-Si diodes grown by pulsed laser deposition

E.L. Papadopoulou[1,2,*], D. Louloudakis[3], M. Varda[3], M. Kayambaki[1],
M. Androulidaki[1], G. Huyberechts[5], and E. Aperathitis[1]

[1] Institute of Electronic Structure & Laser, Foundation for Research and Technology –Hellas, P.O. Box 1527, Heraklion 71110, Crete, Greece
[2] Materials Science & Technology Department, University of Crete, P.O. Box 2208, 71003 Heraklion, Crete, Greece
[3] Physics Department, University of Crete, P.O. Box 2208, 71003 Heraklion, Crete, Greece
[4] Umicore Group Research & Development Kasteelstraat 7 B-2250 Olen Belgium
*eviep@iesl.froth.gr

In the recent years there has been an emerging challenge for the development of materials that incorporate high optical transmittance as well as high electrical conductivity, towards the development of transparent optoelectronic nano-devices. However, research has advanced much more in the case of materials exhibiting n-type conductivity, such as ZnO or ITO. Still, materials exhibiting p-type conductivity lack behind, with materials exhibiting good transmission in the visible, but quite lower carrier concentration comparing with the n-type ones.
In this work we present results on $SrCu_2O_2$ a wide band gap transparent conducting oxide (TCO). Single phased $SrCu_2O_2$ has been grown on fused silica substrates via pulsed laser deposition (PLD) at different substrate temperatures and ambient oxygen pressures. The structural, optical and electrical properties have been studied. All SCO films were shown to be p-type semiconductors, with a carrier density in the order of 10^{14} – 10^{16} cm^{-3} and resistivity in the order of 300 Ωcm. Their transparency reaches 80%. Post-deposition annealing in O_2 environment reduced resistivity from 293 Ωcm to 60 Ωcm. The SCO thin film with the optimum properties was deposited on n-Si wafer and the properties of the p-SCO/n-Si diode, just after deposition as well as after thermal treatment, was investigated using I-V, C-V, DLTS and PL measurements. The use of SCO/Si heterostructure for electronic as well as optoelectronic applications will be addressed.

ABSTRACT: P II.16

Investigation of top gate electrode variations for high-k gate dielectric MOS capacitors

D.C. Moschou[1], E. Verelli[2], D.N. Kouvatsos[1], P. Normand[1], D. Tsoukalas[2], A. Speliotis[3], P. Bayiati[1], D Niarchos[3]

[1]Institute of Microelectronics, NCSR Demokritos, 15310 Agia Paraskevi, Greece, e-mail: dmoschou@imel.demokritos.gr
[2]National Technical University of Athens, School of Applied Sciences, 15780 Zografou, Greece, e-mail: verelli@central.ntua.gr
[3]Institute of Materials Science, NCSR Demokritos, 15310 Agia Paraskevi, Greece, e-mail: tspeliotis@ims.demokritos.gr

Capacitors with a high-k HfO_2 film as gate dielectric were fabricated, using three different variations for the top gate electrode. This way we would be able to acquire important information on which kind of gate material should be used in combination with HfO_2 as a gate insulator for optimum performance. The300Å HfO_2 film was sputtered at a temperature of T=200ºC, pressure of $P=8\cdot10^{-3}$ mtor, and with a Ar/O_2 ratio of 6:1. The variations of gate electrode were e-gun evaporated Al, sputtered W and CVD polysilicon followed by ion implantation and annealing.
The capacitors were then characterized with capacitance-voltage measurements and current-voltage measurements. Through the C-V characteristics we observed that the presence of interface states was more pronounced for the capacitors with W as gate electrode, while for the samples with Al and polysilicon gates their effect was less pronounced. Also, we observed that performing capacitance-voltage loop measurements, even for low voltages, the capacitors with W gates show very large hysterisis, indicating the trapping of charge within the dielectric. As for the other gate electrodes, again the Al and polysilicon gates follow the same behavior, not showing prominent hysterisis, therefore charge trapping. Through the current-voltage measurements, we were able to investigate the effects of each different gate electrode on the reliability of the high-k capacitors. These characteristics showed that the capacitors with W gates are the ones that break down at lower voltages, while the samples with Al and polysilicon gates once again show similar behavior, breaking down at nearly the same voltages. However, it is worth noticing that for both the capacitors with W gates and the ones with polysilicon gates, large parasitic capacitances were probed through the smaller than expected maximum capacitance of the C-V characteristics, indicating that further optimization of the respective processes is required.

ABSTRACT: P II.17

The effect of crystallization technology and gate insulator deposition method on the performance and reliability of polysilicon TFTs

Despina C. Moschou[1], Giannis P. Kontogiannopoulos[1], Dimitrios N. Kouvatsos[1] and Apostolos T. Voutsas[2]

[1]Institute of Microelectronics, NCSR Demokritos, Patriarchou Grigoriou Str., Aghia Paraskevi 15310, Greece, e-mail: dmoschou@imel.demokritos.gr
[2]LCD Process Technology Laboratory, Sharp Labs of America, 5700 NW Pacific Rim Boulevard, Camas, Washington 98607, USA, e-mail: AVoutsas@sharplabs.com

Polysilicon TFTs were fabricated using solid phase crystallization (SPC) and also two different excimer laser annealing techniques (ELA) for polysilicon crystallization. Moreover, we tried two different gate oxide deposition methods, using PECVD or TEOS. Comparing the characteristics of the fabricated TFTs, we were able to probe the effects of the polysilicon crystallization techniques and the gate oxide deposition methods on TFT performance and reliability. This way, an optimization of the TFT fabrication procedure could be possible.
After calculating the parameters of several TFTs from each sample we observed that the ELA devices were clearly superior to SPC ones, since the grains are much larger and of better intragrain quality. Comparing the parameters of the two different ELA samples with the same PECVD gate insulator, we observed that the directional technique, yielding long and narrow grains, showed superior performance over the 2-shot one, yielding rectangular crystal domains with increased surface roughness. Finally, the devices with PECVD deposited gate oxide showed worse performance, possibly due to plasma induced damage.
As far as the reliability is concerned, we observed much more intense stressing effects in SPC devices than in ELA ones and differences in the degradation mechanisms. Comparing the two different ELA crystallization techniques, we observed the same degradation mechanisms, but also a reliability superiority of the directional sample, attributed to its less pronounced surface roughness. Finally, the nature of the gate oxide seemed to have significant effects on device reliability, since different degradation mechanisms were observed for PECVD and TEOS oxides. Possible channel shortening effects were observed only in TEOS oxide TFTs, along with an initial decrease of its threshold voltage.
After this analysis we were able to conclude that ELA TFTs, specifically directional ones, show superior performance and reliability and also that TFTs with TEOS deposited gate dielectric show better performance.

ABSTRACT: P II.18

Development of InN based heterostructures and nanostructures

E. Iliopoulos[1], E. Dimakis, K. Tsagaraki, and A. Georgakilas

Microelectronics Research Group, Institute of Electronic Structure and Lasers, Foundation for Research and Technology-Hellas, P.O.Box 1527, 71110 Heraklion-Crete, Greece; and Physics Department, University of Crete, Heraklion-Crete, Greece, [1] E-mail: iliopoul@physics.uoc.gr

Indium nitride is a promising member of the III-nitrides family for the development of telecommunications wavelength optoelectronic devices and high-speed electronics. Aiming towards real-life applications, the development of high quality heterostructures and nanostructures, incorporating InN active layers is essential. In this work the achievement of multi-quantum well (MQW) $InN/In_xGa_{1-x}N$ heterostructures and the controllable growth of InN quantum dots on GaN (0001) surface are reported.
MQW structures with InN wells and InGaN barriers were developed by plasma assisted molecular beam epitaxy, at the growth temperature of InN, on GaN(0001) templates. InGaN buffer layers, with compositions identical to the barriers' ones were employed prior to the MQW growth. This way, the formation of extended defects within the heterostructures, due to the large lattice mismatch between InN and GaN, can be avoided. High resolution x-ray diffraction (HR-XRD) studies reveal excellent structural characteristics. Up to 4th order satellite superlattice peaks are resolved in the ω-2θ scans around the GaN (0002) Bragg point.
The growth properties of InN quantum dots on GaN (0001) surfaces by molecular beam epitaxy were investigated. The dependence of the dimensions and density of the dots on the nucleation temperature and their evolution during growth at a constant substrate temperature are described. It is shown that both dimensions and density can be accurately controlled through nucleation temperature and deposition time. In the range from 400^oC to 450^oC, the formation of InN quantum dot structures of small dimensions and high density is feasible. InN dots with less than 3nm height, less than 22nm diameter and with density higher than $1.7\times10^{11}cm^{-2}$ have been obtained.

ABSTRACT: P II.19

Non-Melt Laser annealing of Plasma Implanted Boron for ultra-shallow junctions in Silicon

A. Florakis[1*], N. Misra[2], C. Grigoropoulos[2], D. Tsoukalas[1],
K. Giannakopoulos[3], A. Halimaoui[4]

1 Department of Applied Physics National Technical University of Athens, 9 Heroon Polytechniou Str.,15780 Zographou, Greece (e-mail*: anflorak@central.ntua.gr)
2 Department of Mechanical Engineering, University of California Berkeley, 6177 Etcheverry Hall CA 94720-1740
3 Institute of Materials Science, NCSR Demokritos, 15310 Aghia Paraskevi, Greece
4 ST Microelectronics, 850 rue Jean Monnet, 38926 Crolles cedex, France

In this paper we present the implementation of two emerging techniques; non melt laser annealing and plasma doping implantation (PLAD) for the formation of ultra-shallow p^+/n junctions. PLAD offers the possibility of obtaining ultra shallow as implanted profiles (χ_j less than 20nm) at very high Boron concentration values especially near the surface. Ions from BF_3 plasma have been implanted in n-type silicon wafers with 0.4keV energy at 3E15 at/cm^{-2} dose. Laser annealing using a KrF Excimer laser (λ=248nm), at energy fluencies below and close to the c-Si melting threshold, leads to enhancement of the activation levels of Boron dopants via a diffusionless procedure. Moreover, in this way we can achieve the complete removal of the damage caused by the BF_3 plasma implantation and a full recrystallization of the surface layers. Using the benefits of both these methods we can obtain ultra shallow and defect free junctions which can fulfill the requirements imposed by the ITRS roadmap for the 45nm node for CMOS devices. Several fluency values have been used in order to accurately determine the fluency threshold. Van der Pauw sheet resistance and SIMS measurements have been conducted for the determination of the optimum annealing conditions in terms of shallow junction depth and low sheet resistance. Finally, the evolution of the recrystallization of the amorphized layers and the removal of the defects throughout increasing energy fluencies has been monitored by cross-sectional TEM measurements.

ABSTRACT: P II.20

RF MEMS Dielectric Charging Effect Estimation due to 1MeV γ-Ray Photons Irradiation

V G Theonas[1*], G J Papaioannou[1], G Konstantinidis[2] & J Papapolumerou[3]

[1] Solid State Physics Section, Physics Dept. , N.K.U.A, Panepistimiopolis Zografos, 15784 Athens, Greece
[2] Institute of Electronic Structure and Laser, Foundation for Research and Technology – Hellas, Vassilika Vouton, 71110 Heraklion, Crete, Greece
[3] School of ECE, Georgia Institute of Technology, Atlanta, GA 30332-0250, USA
*vtheonas@phys.uoa.gr

SiO_2 and Si_3N_4 as well as other insulating films are used in MEMS. However, their tendency for electrostatic charging diminishes the device reliability. The charging effect becomes significant when these devices are subjected to ionizing radiation. The irradiation induced charging depends on the nature of irradiation, the vicinal metal layers, and the metal-insulator interface properties. The sensitivity of RF MEMS to 1MeV photons is presented, taking into account the simulation of charge generation to device's structure with different insulating layer composition and thickness.

The aim of the present work is to investigate the MEMS dielectric charging effect, while subjected to γ-rays electromagnetic ionizing radiation. Our target is to obtain a better understanding on RF MEMS and their sensitivity to ionizing radiation, and compare our results with the available scattered information.

We simulated the effect of γ-ray photons on a simple Metal–Insulator–Metal (M.I.M.) structure, resembling an RF switch, of an active area of 60 x 60 μm. The dielectric layer thickness was increased from 100 to 420nm. Several dielectric materials (Si_3N_4, SiO_2, AlN, Al_2O_3 and the high k HfO_2 and Ta_2O_5) have been supposed to fill the insulating film. The materials choice was based on their compatibility to RF MEMS technology, electrical characteristics and structural and physical properties.

Simulation results indicated that in all cases a net positive charge is build up in the dielectric material. Finally, the magnitude and distribution of charge was found to depend strongly on the material density and mean atomic number.

ABSTRACT: P II.21

Concurrent Electrothermal Experimental Analysis of RF-MEMS Switches for High Microwave Power Handling

F. Coccetti and R.Plana

LAAS-CNRS, 7. Avenue du Colonel Roche, 31077 Toulouse Cedex 4, France

RF induced heat generation is a very critical issue in the case of RF-MEMS switches, but so far, very few efforts have been dedicated to the experimental characterization of such phenomenon.
The present work focuses on capacitive switches, in both serial and shunt configurations. In the capacitive shunt switch, the RF signal propagating through the coplanar transmission line presents in the up position a low capacitive reactance. When actuated, the bridge collapses on a thin SiN dielectric layer and the higher capacitance yields a low-impedance RF path to ground (isolation -15dB@10GHz). On the other hand, when the membrane is in the down position the high capacitance yields a short circuit for the RF signal path.
Both structures have been characterized with the measurement test set up which will be presented and has been used in both, up and down position for a 10 GHz and 6.3W of CW incident power. The temperature maps resulting from the measurements at RF steady-state in both working conditions (ON/OFF states) and both switch configurations have shown that the maximum recorded temperature is localized on the edge of the bridge above the center point of the signal conductor. Values of 39.1 and 72.9 °C are reported in up and down position respectively. On the other hand the different working conditions of the serial switch yield an opposite trend and a reduced temperature rise. In the OFF state (membrane up) the maximum temperature is only 34.4 °C. This can be explained by the fact that there is no current flowing through the switch (because of the gap in the signal line). In the ON state, as the RF signal is passing through the device and the membrane is in contact with the underneath signal line, the temperature is better distributed and it remains at 42.2 °C.

ABSTRACT: P II.22

Peculiarities of charge retention in nanodot NVM structures under the unipolar bias conditions

V. Turchanikov[1]*, A. Nazarov[1], V. Lysenko[1], V. Ievtukh[1], O.Winkler[2], M. Baus[2], B. Spangenberg[2], H. Kurz[2]

[1]Lashkaryov Inst. Of Semicond. Physics NAS Ukraine, 03028, Kyiv 28, Prosp. Nauki 41, UKRAINE,
*Corresponding author, e-mail: turchan@lab15.kiev.ua
[2]Institut fur Halbleitertechnik, RWTH Aachen, Sommerfeldstrasse 24, 52074 Aachen, GERMANY

In this work we present the results of retention measurements for NVM structures with nanodots included. These structures were fabricated on p-Si substrate that was thermally oxidized with 3 nm SiO_2 as a tunnel oxide. Subsequent LPCVD and remote plasma enhanced CVD processes were carried out for the deposition of Silicon nanodots and a 20 nm control SiO_2 layer, respectively.
In contrast to conventional floating gate NVM structures these retention measurements were prepared under unipolar charging conditions; i. e. the same programming voltage polarity was used for writing and erasing (W/E) of the floating gate NVM structures. We found that negative charge accumulation in our NVM structures is very unstable due to the swift leakage of electrons into the Si substrate through the tunnel SiO_2. This relaxation is completed after a few seconds. Contrarily, the compensation of accumulated positive charge in the nanodots is a matter of several hundred seconds. This phenomenon can be understood with the fundamental difference between floating gate and nanodot NVM structures – namely the ratio of the surface and bulk Si atoms that can vary by orders of magnitude. An elementary two-layer charge accumulation model is presented that explains the retention characteristics of nanodot NVM structures under the unipolar biasing conditions.

ABSTRACT: P II.23

Performance of Thin-Film Transistors fabricated by Sequential Lateral Solidification crystallization techniques

M.A. Exarchos[1a], D.C. Moschou[2a], G.J. Papaioannou[1b], D.N. Kouvatsos[2b], A.T. Voutsas[3]

1 Physics Department, National and Kapodistrian University of Athens, Athens 15784, Greece, mexarcho@phys.uoa.gr (a), gpapaioan@phys.uoa.gr (b)
2 Institute of Microelectronics, NCSR Demokritos, Agia Paraskevi 15310, Greece, dmoschou@imel.demokritos.gr (a), dimkouv@imel.dmokritos.gr (b)
3 LCD Process Technology Laboratory, Sharp Labs of America, Camas, WA 98607, USA, avoutsas@sharplabs.com

In this work we investigated and assessed the application of novel SLS ELA polysilicon crystallization techniques for top gate TFTs. These techniques are based on 2^6-shot, MxN#8, and MxN advanced irradiation schemes, yielding different polysilicon film textures and grain structures. Aiming at the relation between polysilicon structural characteristics and TFT reliability standards, we studied TFT behavior for a) unstressed devices, b) devices stressed under worst ageing conditions.
In the first case, drain current transients were recorded, upon TFT switch from OFF- to ON-state. Excellent fitting results were extracted by applying stretched (or dual stretched) exponential law fitting analysis on transients. The study of relaxation time constant revealed that different thermally activated mechanisms contributed to the transient behavior. The transients are strongly affected by gate oxide polarization caused by polysilicon film surface roughness, for temperatures between 110-300K. Carrier generation-recombination mechanisms due to planar defects prevailed, for temperatures higher than 300K. The respective activation energy values were calculated.
In the second case, DC hot-carrier stress was applied for TFTs crystallized with the three aforementioned techniques. Observing that the M×N advanced sample was much more sensitive, due to its smaller crystal domain, therefore more polysilicon protrusions in the gate oxide, a milder stress was applied to probe its degradation behavior. The samples with more surface asperities due to smaller crystal domains had the largest V_{th} degradation, since the local field enhancements caused by the protrusions increase charge injection in the gate oxide. The same degradation intensity order is observed for the subthreshold slope, but with smaller differences, since S is a parameter less dependent on oxide injection. The fact that $G_{m,max}$ degradation of the samples, mostly affected by trap generation within the polysilicon bulk, is similar, further supports that the surface characteristics of the films mostly increase the oxide injection.

ABSTRACT: P II.24

Plasma nanostructuring of PDMS surfaces and its effect on protein adsorption

Maria-Elena Vlachopoulou[1], Panagiota Petrou[2], S. Kakabakos[2], A.Tserepi[1], E.Gogolides[1]

[1] Inst.e of Microlectronics, NCSR "Demokritos", PO Box 60228, Aghia Paraskevi, Attiki, 153 10 Greece
[2] Inst. of Radio Isotopes & Radio Diagnostic Products, NCSR "Demokritos", PO Box 60228, Aghia Paraskevi, Attiki, 153 10 Greece

Poly-dimethylsiloxane (PDMS) is a biocompatible elastomeric material widely used in the fabrication of microfluidic systems and biochips, because of the ease in fabrication, its inertness and transparency. PDMS can be used as a structural as well as a functional material of devices and chips with its surface topography affecting the device performance. In this work, we present the formation of columnar-like nanostructures on PDMS surfaces by SF_6 plasma treatment in a control way, and the utilization of such topography to increase protein adsorption on such surfaces.
Periodic columnar-like PDMS structures are obtained by SF_6 plasma treatment, where selective etching of certain components of the polymer with simultaneous creation of etching resistant components takes place, under conditions of anisotropic etching. The height of columns varies from tens of nm to tens of μm by increasing the duration of SF_6 plasma treatment, while their density is also affected, as aggregates of nanocolumns are created at longer treatment time. Besides plasma processing parameters (time, bias), material processing parameters (solvents) are able to control surface nano-topography.
The wettability of SF_6 plasma treated surfaces is investigated at newly processed and aged nano-structured PDMS surfaces. Furthermore, protein adsorption on fresh and aged plasma nano-structured surfaces is investigated and in all cases, an increase in protein adsorption is observed by fluorescence on PDMS nano-columnar surfaces compared to flat untreated PDMS surfaces, probably since total surface area is larger on nano-textured surfaces. Best spot morphology is obtained for short plasma treatments, as at these conditions nanostructures are more uniformly distributed on the PDMS surface. Application in protein-array technology is intented.

ABSTRACT: P II.25

Detection of CO and NO using low power Metal Oxide sensors

R. Triantafyllopoulou & C. Tsamis

NCSR "Demokritos", Institute of Microelectronics, 15310, Aghia Paraskevi, Athens, Greece, e-mail: ctsamis@imel.demokritos.gr

Solid state chemical sensors are the most common devices for the detection of toxic gases, like CO and NO. Their principle of operation is based on the changes of the conductivity of a sensitive material, which is deposited between two electrodes, due to the adsorption of reducing or oxidizing agents onto its surface. In this work we present detailed characterization of low power SnO_2 gas sensors based on Porous Silicon micro-hotplates for the detection of CO and NO gases. The fabrication of the sensors has been described in detail elsewhere [1]. The response of the SnO_2 gas sensors was measured for various gases, such as CO and NO and CO/NO mixtures for various gas concentrations (100-500 ppm). Analysis was performed in isothermal operating mode, by keeping constant the micro-hotplate temperature and in pulsed temperature mode, by applying voltage pulses to the heater. In this case, the sensitivity and selectivity of the sensors was estimated as a function of the total shape of the pulse cycle, the duration of the pulses and the temperatures of the "hot" and the "cold" part of the measuring cycle. In both cases, the response of the sensors increased as the temperature and the concentration of the detecting gases increased. Comparing the two different operation modes, the sensors show higher sensitivity in pulsed temperature mode, in comparison with the continuous heated mode. With this technique, a significant reduction of power consumption can be achieved, because the sensor response is higher at the "cold" part of the measuring cycle. Moreover, the sensors show significant selectivity in detecting NO, so that discrimination of the two gases could be achieved.

The present work has been co-funded by European Community funds and by National funds (E.P.E.A.E.K.), under the 'Archimides' programme

[1] M. C. Horrillo, I. Sayago, J.P. Adrados, J. Gutiérrez, R. Triantafyllopoulou, S. Chatzandroulis, C. Tsamis, "SnO_2 sensors integrated on porous Si microhotplates to detect NH_3", Eurosensors XX, Goteborg, Sweden, September 17-20 (2006)

ABSTRACT: P II.26

A Comparison of Two Analogue Buffers, Implemented with Low Temperature Polysilicon Thin-Film Transistors, for Active Matrix Applications

Ilias Pappas[1], Stilianos Siskos[1], Gerald Ghibaudo[2] and Charalambos A. Dimitriadis[1]

[1] Department of Physics, Aristotle University of Thessaloniki, 54124 Thessaloniki, Greece, ilpap@auth.gr

[2]*Institude of Microelectronics, Electromagnetic and Photonics (IMEP-MINATEC), National Polytechnic of Grenoble, 3 Parvis Louis Neel, 38054, Grenoble, France*

Low temperature polysilicon thin-film transistors (LT poly-Si TFTs) have been widely investigated due to their potential applications in large area electronics [1], such as flat displays, memories and scanners [2], [3]. The main disadvantage of the LT poly-Si TFTs is the variation of the threshold voltage from device to device, even if the devices are implemented on the same wafer and with the same procedure [4], [5]. In this paper, a comparison of two different source- follower type analogue buffers, for Active Matrix Liquid Crystal Displays (AMLCDs), is presented. These two buffers are shown high immunity to the threshold voltage variations and they can be used as the buffers of the row drivers of an AMLCD pixel panel.

The two buffers, with their time diagrams, are shown in Fig. 1 and Fig. 2 [6], [7]. The first buffer consists of five poly-Si TFTs, one bias voltage and needs three additional signals. The second buffer consists of six poly-Si TFTs and needs three additional signals. Both buffers' operations are divided into three phases [6], [7]. The verification of the functionality of the buffers was made via simulations with Synopsys HSpice. In order to be the simulations realistic, parameters extraction of poly-Si TFTs was made from fabricated poly-Si TFTs [6]. The offset error, which means the different between the input and the output voltage, was measured from the transient response of the two buffers and when the input voltage varies from 2 V up to 10 V. The second buffer exhibits an improved performance, as the offset error concern, by an average of 9% of all input voltages. Also, the second buffer present lower power consumption by 11 %, caused by the lower supply voltage that is needed. Finally, the second buffer represents higher immunity to the threshold voltage variation. This was verified by Monte Carlo simulations [6], [7].

A comparison between two analogue buffers, for AMLCDs applications, was presented in this abstract. Conclusively, the second buffer has shown an improved performance compared to the first one. But, the selection of which it will be used each time depends on the specifications of the application.

References

[1] W. G. Hawkins, "Polycrystalline-silicon device technology for large area electronics," *IEEE Trans. Electron Devices*, vol. 33, pp. 447-450, 1986.

[2] H. Hayashi, M. Negishi, and T. Matsushita, "A thermal printer head with CMOS thin-film transistors and heating elements integrated on a chip," *Tech. Dig. IEEE Int. Solid-State Circuits Conf.*, pp.266-270, 1988.

[3] N. D. Young, G. Harkin, R. M. Bunn, C. McCulloch, and I. D. French, "The fabrication and characterization of EPROM array on glass using low-temperature poly-Si TFT process," *IEEE Trans. Electron Devices*, vol. 43, pp.1930-1936, 1996.

[4] A. G. Lewis, D. D. Lee, and R. H. Bruce, "Polysilicon TFT circuit design," *IEEE Journal of Solid-State Circuits,* vol. 27, pp. 1833-1842, 1992.

[5] M. D. Jacunski, M. S. Shur, and M. Hack, "Threshold voltage, field effect mobility and gate-to-channel capacitance in polysilicon TFT's," *IEEE Trans. on Electron Devices,* vol. 43, pp. 1433-1440, 1996.

[6] I. Pappas, S. Siskos and C. A. Dimitriadis, "A new analogue buffer using low-temperature polysilicon thin-film transistors for Active Matrix Displays", *IEEE Transaction On Electron Devices,* vol 54, no 2, February 2007.

[7] I.Pappas, S.Siskos, C.A. Dimitriadis and G. Ghiabaudo, "A new topology of analogue buffer using low-temperature polysilicon thin-film transistors for liquid crystal displays applications",accepted in XXI Conference on Design of Circuit and Integrated Systems (DCIS), November 2007, Sevilla, Spain.

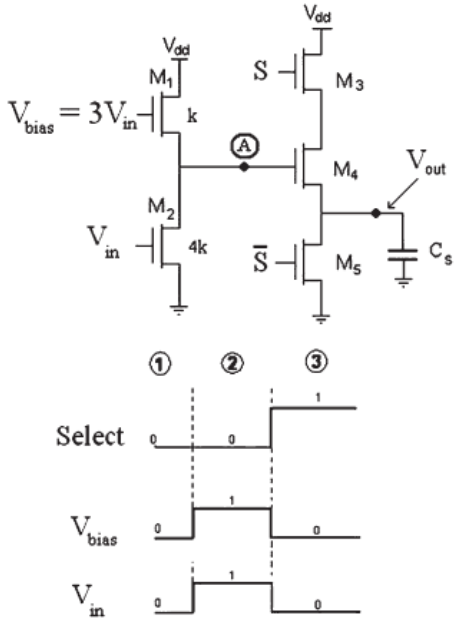


Fig. 1. The first source-follower type analogue buffers and its signals timing diagrams

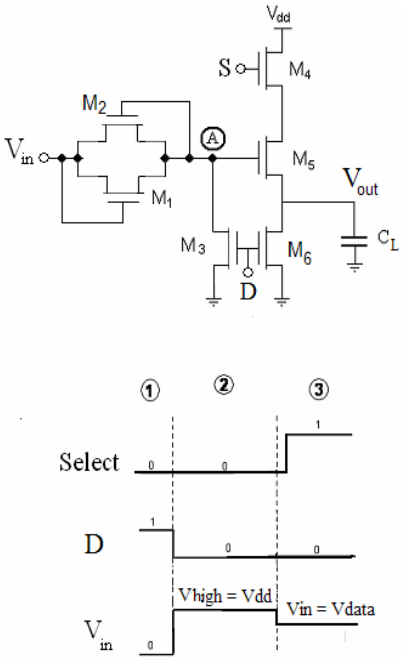


Fig. 2 The second source-follower type analogue buffer and its signals timing diagram

ABSTRACT: P II.27

A fully 2-dimensional, quantum mechanical calculation of short-channel and drain induced barrier lowering effects in HEMTs

G. Krokidis, J. P. Xanthakis and N. Uzunoglu

Electrical and Computer Engineering Department, National Technical University of Athens, Zografou, Athens 15780, Greece

We have performed a fully 2-dimensional (2D) Poisson, Schrödinger and continuity equations modeling of nanometer gate HEMTs. For the electron density n(x,y) in the channel we use the discrete levels obtained from the Schrödinger equation and the corresponding 1D density of states (DOS), so that a fully quantum representation of n is obtained. The threshold voltage reduction ΔV_T we obtain at small V_{DS} is in very good agreement with experimental values. By comparison with our classical calculations (a subset of our model) we deduce that quantum effects are not important for the calculation of ΔV_T. However quantum effects become increasingly important as V_{GS} increases beyond V_T at small V_{DS} .The deviation between classical and quantum values in the current are of the order of 40% -80% depending on the device. As V_{DS} increases and reaches saturation this percentage deviation decreases but its absolute value (in mA/mm) increases. These effects become more acute as the gate length becomes shorter.

ABSTRACT: P II.28

Hydrophobic plasma-deposited fluorocarbon films as a means for biofluid transport and selective adsorption of biomolecules on lab-on-a-chip devices

Pinelopi Bayiati[1*], Angeliki Tserepi[1**], Panagiota S. Petrou[2], Sotirios E. Kakabakos[2], Evrimahos Matrozos[1], Dimitris Goustouridis[1], Konstantinos Misiakos[1], Evangelos Gogolides[1]

[1]Institute of Microelectronics-NCSR "Demokritos", POB 60228, 153 10 Aghia Paraskevi, Attiki, Greece, *pinelopi@imel.demokritos.gr, **atserepi@imel.demokritos.gr
[2]Institute of Radioisotopes & Radiodiagnostic Products-NCSR "Demokritos", POB 60228, 153 10 Aghia Paraskevi, Attiki, Greece

In the present work, plasma-deposited fluorocarbon (FC) films are investigated as hydrophobic coatings defining areas for biofluid transport and others for adsorption of biomolecules, simultaneously on the same chip. FC films were created in C_4F_8 plasma and optimization of their properties led to deposition in two different regimes: one where FC films deposited on Si_3N_4-covered electrodes exhibit reversible electrowetting [1], and a second where FC films selectively deposited on SiO_2 (or Si_3N_4) areas of patterned Si surfaces lead to selective biomolecule adsorption.
During electrowetting experiments, FC films showed high contact angle modulation upon voltage application, good contact angle reversibility upon voltage removal and negligible protein adsorption, all independent of pH and concentration of protein solutions, and applied voltage polarity. Such properties render FC films appropriate for droplet transport based on electrowetting. Fluid transport was demonstrated on an open microfluidic device, fabricated using plasma-deposited optimized FC films, consisting of a series of micro-electrodes sequentially activated to promote droplet transport.
Selective bio-adsorption was also demonstrated onto plasma-modified areas on the same hydrophilically/ hydrophobically patterned substrate, resulted from a standard lithographic process and subsequent treatment in C_4F_8 plasma. FC film was selectively deposited on Si areas, whereas, at the same time, SiO_2/Si_3N_4 patterns were etched and chemically modified retaining their hydrophilicity. When plasma-treated patterned substrates were immersed in protein solutions, without any further chemical modification, selective protein adsorption took place only on the hydrophilic SiO_2/Si_3N_4 areas. This method can be used for the fabrication of bio-microarrays [2] with very small spot size (depending on the resolution of the lithographic method), high spot density, and increased signal to noise ratio due to elimination of non-specific binding.

[1]. R. Mukhopadhayay, Anal. Chem. 78, 1401 (2006).
[2]. M. Cretich, F. Damin, G. Pirri, M. Chiari, Biomolecular Engineering 23, 77 (2006).

ABSTRACT: P II.29

A calculation of the current through the ZnO/ZnMgO/ZnO/ZnMgO/Zno double barrier system

E.I. Sfakianakis[X] & J.P. Xanthakis[X]

[X] Faculty of Electrical and Computer Engineering, National Technical University of Athens, Zografou Campus, Athens 15773, Greece, e-mail: jxanthak@central.ntua.gr

We calculate the current through the recently fabricated ZnO/ZnMgO/ZnO/ZnMgO/ZnO double barrier system which has the unusual characteristic that the negative resistance peaks appear at a external voltage much higher than the conduction band discontinuity due to ohmic losses at the 'emitter" and "collector" regions. The calculation does not use a semi-empirical lorentzian function for the transmission coefficient but instead solves Shroedinger equation in the effective mass approximation by expanding in Airy functions in both regions and calculating the transmission coefficient from the ratio of the coefficients of the incoming and outgoing wave. We obtain three peaks in exact analogy with our previous calculation (Solid State Electronics, 48, 2099, 2004) of the optical excitations in this system. Furthermore by use of an iterative method we are able to reproduce the experimental I-V characteristic of the device.

ABSTRACT: P II.30

Modeling MOSFET Gate Length Variability for Future Technology Nodes

George P. Patsis[1]

Institute of Microelectronics, NCSR Demokritos, Athens, 15310 Greece,
e-mail: gpatsis@imel.demokritos.gr

According to technology roadmap predictions, semiconductor device dimensions will shrink to lower than 30 nm by the end of this decade, introducing a wide range of design challenges in terms of accurate modeling of device and interconnect behavior, robustness and reliability. At the same time, the number of devices in integrated systems (System-on-Chip, SoC) will continue to increase at an exponential rate, soon exceeding 1 billion devices. Thus, the integrated circuit/system designers face a multi-faceted problem that involves nano-scale devices with less than ideal characteristics, very high integration densities (i.e. giga-scale complexity), very high operation speeds and data transmission rates, and system-level integration of analog and digital functions.
Additionally, gate length variability due to intra or inter die variations can lead to considerable mismatch between devices even inside the same chip. This variability has to be considered in detail and new device models should be developed, aiming in modeling its effects on the electrical characteristics devices.
In the proposed work the Philips MM11 MOSFET model is used as a base and is extended to incorporate gate length variability. This is introduced by dividing the device width into sub-units following a Gaussian gate length distribution, with appropriate line-width roughness. The combined model will be used to quantify threshold voltage shift, leakage current and sub-threshold power consumption in terms of gate line-width roughness. The model will be coded in VHDL-AMS in order to be used for simulation of circuit behavior inside the framework of appropriate system simulation software such as Asfot's Simplorer or Mentor Graphics' Advance MS.

ABSTRACT: P II.31

Flexible Organic Light Emitting Diodes (OLEDs) based on blue emitting polymers

M. Vasilopoulou[1*], A. Botsialas[1], D. Georgiadou[1], L. Palilis[1], P. Bayiati[1], N. Vourdas[1], P. S. Petrou[2], G. Pistolis[3] and P. Argitis[1]

[1]Institute of Microelectronics, NCSR "Demokritos", 15310 Athens, Greece
*mariva@imel.demokritos.gr
[2]Immunoassay Laboratory, I/R-RP, NCSR "Demokritos", 15310 Athens, Greece
[3]Institute of Physical Chemistry, NCSR "Demokritos" 153 10 Athens, Greece.

Organic light emitting diodes (OLEDs) are currently under active research due to their applications in flat panel displays and solid state lighting. Whether for displays or lighting, billboards or posters and signaling, the big breakthrough in OLEDs comes when they can be thin and flexible yet give all colors at high brightness levels with long life.
In the present paper different colour flexible OLEDs were demonstrated using suitable emitters dispersed in a blue highly efficient electroluminescent poly(fluorenyl) (PF).
The flexible electroluminescent devices were fabricated on Indium Tin Oxide (ITO) coated polyethylene terephthalate (PET) substrates. The PET substrates with ITO coating had a sheet resistance of 35 Ω per sq. cm. Before deposition of organic layers they were cleaned by sequential rinsing in de-ionized water, acetone and isopropyl alcohol for 10 min in ultrasonic baths, dried in a vacuum oven for 2 h at 60 °C and then treated by O_2 plasma for 5 min. A 40 nm thick film of PEDOT-PSS was spin coated on top of ITO layer to improve hole injection and substrate smoothness and then the emitting layer was spin coated. Aluminum cathode electrodes of 300 nm thickness were deposited on top of the emitting layer by vacuum evaporation. The emitting layer was based on the blue emitting Poly[9,9-di-(2'-ethylhexyl)fluorenyl-2,7-diyl] (PF). For different colour light emitting devices suitable emitters were dispersed into the polymer matrix in suitable quantities. The selection of the emitters is based on their capability to be effective energy transfer acceptors from the blue emitting contucting PF. In particular, green OLEDS were demonstrated based on PF containing the emitter 1-[4-(dimethylamino)phenyl]-6-phenylhexa-1,3,5,-triene (DMA-DPH), whereas in red OLEDs the emitter (4-dimethylamino-4'-nitrostilbene) (DANS) was dispersed into the polymer matrix. In this way highly efficient blue, green and red flexible OLEDs based on blue emitting PF were demonstrated. Intermediate colours and white light can also be obtained by mixing both emitters in suitable concentrations.

ABSTRACT: P II.32

Design To Improve The Capacitive Contact Quality in Piezoelectric Actuation.

H.Achkar[1], D.Peyrou[1], F.Pennec[1], M.Al Ahmad[1], P.Pons[1], & R.Plana[1]

[1]Groupe MINC, LAAS-CNRS , University of Paul Sabatier , 7 Avenue du colonel Roche 31077 Toulouse, France, e-mail: hachkar@laas.fr

RF-MEMS switches with piezoelectric actuation finds interest for many telecommunication applications specially that it operates at low actuation voltages, high switching speed, and reduces the main effect of stiction which is the dielectric charging. Piezoelectric actuation, applies deformations on the extremities of a membrane, especially in capacitor plate switches resulting in a deformed surface. A sensitivity study on the effect of the parasitic air gap thickness, coming from deformations, on the value of the total capacitance was done and showed high sensitivity to the air gap thickness. With the deformation of the plate due to actuation, the capacitance decreases dramatically in the down state and a larger plate area is needed to compensate this loss. To solve these basic problems for a properly operating switch, a new topology reducing the deformation of the membrane in the actuated down state was proposed. This design applies the actuation force at the center of the membrane, leading to a flat contact between the two electrodes forming the capacitance by getting rid even of the initial deformation due to fabrication. The structure is a cantilever where piezoelectric stack is deposited on part of it for actuation and the continuation of the elastic part plays the role of holding the plate and absorbing all the actuation deformation from attaining it. A 2D model, using COMSOL3.3a multiphysics, was built to check the flexibility of the structure and simulations showed an excellent flatness of the plate after actuation while the plate stayed stiff but inclined during the contact phase. In order to have a flat plate all along the actuation phase, we can actuate it by a second cantilever mirror to the first one but a huge reduction in the displacement value was realized. An analytical model of the switch was built using the superposition method.

ABSTRACT: P II.33

SiO_2(Si) films as a medium for charge storage in memory devices

Anatoli Evtukh, Oleg Bratus', Tetyana Gorbanyuk

Institute of Semiconductor Physics, 41 prospekt Nauki, Kyiv 03028, Ukraine, E-mail: evtukh@rambler.ru

Nowadays the nanocrystal nonvolatile memory is intensively developed. The important problem for further progress is connected with optimization of gate multilayer structure. The aim of this work is investigation of thin and ultrathin nanocomposite films SiO_2(Si) as a medium for charge storage in nonvolatile memory. The silicon reach SiO_x films were deposited by two methods, namely: plasma enhanced chemical vapor deposition (PE CVD) and ion-plasma sputtering. The content of the films was determined in the first case by reactive gases SiH_4/N_2O ratio and in the second one by partial pressure of oxygen in vacuum chamber. The following thermal annealing promotes the film structure transition from SiO_x into nanocomposite SiO_2(Si) film containing Si nanocrystals in dielectric matrix. The capacity-voltage and current-voltage measurement of MIS structure with gate nanocomposite SiO_2(Si) films allowed to optimize the technological conditions for obtaining of MIS structure with good charge storage properties. The value and sign of storage charge was determined from shift of C-V characteristics. Analysis of C-V characteristics of MIS structure with nanocomposite films SiO_2(Si) includes equivalent circuit with capacity of nanocrystals connected in parallel to capacity of dielectric. The decrease of capacity in accumulation region caused by nanocrystal capacity was observed. The current transport mechanism through SiO_2(Si) films was also analyzed. The current transport is determined by tunneling through SiO_2 layers between S nanocrystals.

ABSTRACT: P II.34

Hybrid polymer-inorganic solar cells based on polythiophene and phthalocyanine/polyoxometalate blends

Leonidas C. Palilis[1*], Antonios M. Douvas[1], Georgios Chaidogiannos[1], Maria Vasilopoulou[1], Nikos Glezos[1], S. Nespurek[3], P. Falaras[2], & Panagiotis Argitis[1]

[1]Inst. of Microelectronics, National Center for Scientific Research (NCSR) "Demokritos", 15310 Aghia Paraskevi, Athens, Greece.
[2]Inst. of Physical Chemistry, National Center for Scientific Research (NCSR) "Demokritos", 15310 Aghia Paraskevi, Athens, Greece.
[3]Institute of Macromolecular Chemistry, AV-CR, v. v. i., 16206 Prague 6, Czech Republic.
* Corresponding Author, e-mail: lpalil@imel.demokritos.gr

Hybrid polymer organic-inorganic photovoltaic cells (PVs), where conjugated polymers and inorganic semiconductors such as nanoparticles, quantum dots or even amorphous silicon (a-Si) are combined to form highly photoactive blends that also show enhanced bipolar transport, represent a promising approach for achieving high power conversion efficiencies in tomorrow's thin film based solar cells. In this work, we report on the photovoltaic properties of bulk-heterojunction PVs based on donor/acceptor heterostructures of polymeric semiconductors and molecular inorganic nanocluster oxides, fabricated on glass and plastic substrates. Regioregular poly(hexyl-thiophene) (P3HT) and water-soluble Co-based sulfonated pthtalocyanines (PCs) with high hole mobilities were used as electron donors while [6,6]-phenylC_{70}-butyric acid methyl ester (PCBM) and hydrophilic tungstate polyoxometalate derivatives (POMs) such as $H_3PW_{12}O_{40}$ and $[N(n\text{-}C_4H_9)_4]_3PW_{12}O_{40}$ were employed as electron acceptors. PVs exhibited relatively high open circuit voltages of 0.6-0.8 V that were almost equal to the energetic difference between the HOMO of the donor and the LUMO of the acceptor. We investigated the charge separation/collection efficiency in these cells with mobility and photoaction spectral (incident-photon-to-current efficiency) measurements and the illumination intensity dependence of the photovoltaic parameters. AFM spectroscopy was also employed to measure changes in the surface topography and correlate them with device performance. The influence of the series and shunt resistance on the cell performance was examined by fitting the dark and illuminated current-voltage characteristics to the Shockley equation. Optimization of the film morphology and the device processing conditions by solvent screening, pre and post-fabrication annealing and tuning of the blend composition and thickness proved to be critical for achieving high efficiencies. Finally, preliminary results on flexible cells that were fabricated on plastic poly(ethylene terephphalate) (PET) substrates employing ITO or highly conducting poly(3,4-ethylenedioxy thiophene) poly(styrenesulfonate) (PEDOT:PSS) as the anode electrode will be reported and the dependence of the PV performance on the anode conductivity will be discussed.

ABSTRACT: P II.35

Direct laser printing of biomolecules on capacitive sensors

C. Boutopoulos[1], P. Andreakou[1,2], S. Chantzandroulis[3], D. Goustouridis[3], I. Zergioti[1], D. Kafetzopoulos[2] & D. Tsoukalas[1]

[1]National Technical University of Athens, Physics Department, Iroon Polytehneiou 9, 15780 Zografou, Athens, Greece
[2]Foundation for Research & Technology – Hellas, Institute of Molecular Biology and Biotechnology, P. O. Box 1527, Heraklion 71110, Greece
[3]NCSR Demokritos, Institute Microelecronics, Aghia Paraskevi 15310, Greece
email: cboutop@mail.ntua.gr

This work presents our recent results on direct printing of biomaterial on capacitive sensors using a laser rapid prototyping method. The Laser Induced Forward Transfer (LIFT) technique is a direct method allowing the effective deposition of sensitive biomaterials at high spatial resolution. Ultraviolet nanosecond laser pulses (266 nm and 4 ns) have been used for directly printing of biotin on silane coated SiO_2/Si membranes of capacitive sensors. The laser parameters were systematically varied in order to evaluate the effect on the transferred biotin thin films. The laser printing parameters of the biomaterials were correlated with the capacitance change of the sensors. The capacitance change detection is based on the deflection of the membrane and can provide a label-free detection with high sensitivity. This development of high performance miniature biosensors is an advanced tool with growing importance for the disease diagnosis, genome research and drug discovery.

ABSTRACT: P II.36

Development of electrically-pumped microcavity lasers

S. Tsintzos[1,2] , Z. Hatzopoulos[2,3], P. G. Savvidis[1,2], and N.T. Pelekanos[1,2]

[1] Materials Science and Technology Dept., Univ. of Crete, P.O. Box 2208, 71003 Heraklion, Greece, [2] Microelectronics Research Group, FORTH/IESL, P.O. Box 1527, 71110 Heraklion, Greece, [3] Physics Dept., Univ. of Crete, P.O. Box 2208, 71003 Heraklion, Greece

The vertical cavity surface-emitting laser (VCSEL) is considered as one of the most important devices for optical interconnects, enabling ultra-parallel information transmission in lightwave and computer systems. A typical VCSEL consist of a microcavity active region, including several quantum wells (QWs), embedded between two high-reflectivity distributed Bragg reflectors (DBRs). Compared to other lasers, VCSELs are characterized by an extremely small gain medium volume, of a few μm^3, which imposes a careful optimization of all aspects of VCSEL technology. In this report, we review some key results towards the fabrication of a VCSEL in our laboratory.

A prerequisite to construct optimal VCSELs is to achieve (i) DBRs with high reflectivity, and (ii) high quality active QWs with small inhomogeneous linewidth. Towards this end, we have developed DBRs by molecular beam epitaxy (MBE), composed of GaAs/AlAs quarter-wave optical thickness stacks. The experimental reflectivity spectrum of a nineteen period DBR presents maximum reflectivity of about 99.7%, in excellent agreement with the calculated one. Concerning the active QWs, we have grown by MBE a series of carefully optimized $In_{0.1}Ga_{0.9}As$/GaAs QWs. The QW samples were characterized by photoluminescence and the inhomogeneous linewidths observed were as low as 2meV, which is close to the theoretical limit for exciton broadening by alloy fluctuations.

Another key aspect of VCSEL technology is the ability to inject carriers into the central part of the gain volume, thus reducing overall currents and unwanted heating effects. Current confinement is usually obtained by means of selective lateral wet oxidation of an additional AlAs layer ~30 nm thick placed directly on top of the microcavity active region. To achieve AlAs oxidation, water vapor is transported by an inert gas, e.g. nitrogen, inside a tube furnace where the sample is located. The oxidation process depends on various parameters such as nitrogen flow, water vapor and furnace temperature. A set of experiments have been performed to control the oxidation rate of AlAs as a function of the above parameters. Up to now, successful oxidations have been performed on more than 10 test structures under various conditions, and the corresponding oxidation rates have been deduced [1].

[1] This work has been supported by the PENED national project 03EΔ841.

ABSTRACT: P II.37

Room Temperature Tunable Laser Diodes Using Stark Effect Gain Tuning

G. Deligeorgis[1,2], Z. Hatzopoulos[1,2], S. Tsintzos[2,3] and N.T. Pelekanos[2,3]

[1]Physics Depart., Univ. of Crete, P.O. Box 2208, 71003 Heraklion, Greece, [2]Microelectronics Research Group, FORTH IESL, P.O. Box 1527, 71110 Heraklion, Greece, [3]Materials Sci. & Technol. Depart., Univers. of Crete, P.O. Box 2208, 71003 Heraklion, Greece

As dense wavelength division multiplexing (DWDM) is gaining ground in optical telecommunications, there is an ever increasing demand for high efficiency, high speed tunable optical sources. Recently, we have shown that it is possible to tune the wavelength of a single quantum well separate confinement heterostructure (SQWSCH) laser by exploiting the Stark effect in an appropriately designed active region [1]. In this work, we address the issue of room temperature operation of the Stark tunable LDs.

Towards this end, a series of single SQWSCH structures were grown using molecular beam epitaxy on (100) n+ GaAs substrates. The heterostructure description is detailed in Table 1. Varying the Al mole fraction X (from 0.4 to 0.8) and the thickness of the electron and hole barriers (Y and Z) to keep the tunneling time comparable between adjacent quantum wells, the effect of barrier height is studied.

Table 1: Basic structure grown for this study. X,Y and Z varied as described in the text

Layer #	Material	Thickness
1	GaAs	150nm
2	P-$Al_{0.3}Ga_{0.7}As$	1.6um
3	$Al_{0.15}Ga_{0.85}As$	125nm
4	GaAs	4.5nm
5	$Al_xGa_{1-x}As$	Y
6	$In_{0.2}Ga_{0.8}As$	10nm
7	$Al_xGa_{1-x}As$	Z
8	GaAs	12nm
9	$Al_{0.15}Ga_{0.85}As$	125nm
10	N-$Al_{0.3}Ga_{0.7}As$	1.6um
11	n+-GaAs substrate	100um

When electrically pumping the above structure, holes are injected from the top layers whereas electrons are injected from the bottom (the n+ substrate). Layers 5 and 7, surrounding the active QW serve as barriers to the injected carriers. This leads to a substantial accumulation of holes in layer 4 and electrons in layer 8, before they actually transfer into the $In_{0.2}Ga_{0.8}As$ active QW. The resulting space charge electric field leads to band bending, red-shifting by Stark effect the emission of the active QW.

Regarding high temperature operation of Stark tunable LDs, the limiting effect is the carrier transfer time from the collection QWs (layers 4 and 8 in Table 1) to the active QW, which in general depends on temperature. Especially for low barrier heights, the effect is expected to be pronounced. In the structure with $Al_{0.4}Ga_{0.6}As$ barriers we observe an important degradation of the total Stark shift with increasing temperatures, whereas in the one with $Al_{0.8}Ga_{0.2}As$ barriers the total Stark shift remains practically unchanged up to 230K. In the latter LD, we have measured a 8nm wavelength tuning at lasing operation at 230K.

Our results show promise for obtaining room temperature operation of Stark tunable laser diodes.

1.N. Le Thomas, N.T. Pelekanos, Hatzopoulos Z. "Tunable laser diodes by Stark effect" Appl. Phys. Lett. 83 (7): pp 1304-1306,2003

ABSTRACT: P II.38

An all-organic optocoupler based on polymer light-emitting diodes (PLEDs)

M. Vasilopoulou[1*], N. Stathopoulos[2], P. Falaras[3], G. Pistolis[3], D. Davazoglou[1] and P. Argitis[1]

[1]Institute of Microelectronics, NCSR "Demokritos", 15310 Athens, Greece, [2] Dpt. of Electronics, Technological and Educational Institute of Pireaus, Aegaleo, 12244 Greece, [3]Institute of Physical Chemistry, NCSR "Demokritos" 153 10 Athens, Greece.

An optocoupler is a functional device that uses a short optical transmission path to transfer a signal between elements of a circuit, while keeping them electrically isolated. Recently, all-polymeric organic optocouplers have been demonstrated and have attracted increasing attention.

In this work, we demonstrate a polymeric optocoupler by utilizing a donor-acceptor bulk heterojunction polymer photodetector (PD) as the output unit and a polymer light-emitting diode (PLED) as the input unit.

The input unit is a PLED with the structure of glass/indium tin oxide (ITO)/PEDOT-PSS/PF or dye dispersed PF/Al, where PF is either the blue emitting homopolymer poly[9,9-di-(2-ethylhexyl)-fluorenyl-2,7-diyl] or a green emitting copolymer, namely poly[(9,9-dioctylfluorenyl-2,7-diyl)-co-(1,4-benzo-{2,1',3}-thiadiazole)]. The output unit is a PD with the structure glass/ITO/PEDOT-PSS/P3HT:PCBM(1:1 by weight)//Al, where P3HT is poly(3-

hexylthiophene) and PCBM is (6,6)-phenyl-C_{61}-butyric acid methyl ester. The PLED and PD where glued together by index matching epoxy.

In order to increase the device efficiency, it is crucial to achieve the best matching between the PLED's emission and PD's absorption (the absorption spectrum of P3HT:PCBM is in the wavelength region between 450 and 600 nm and has an absorption maximum at 510 nm). Thus, by introducing the green emitter 1-[4-(dimethylamino)phenyl]-6-phenylhexa-1,3,5,-triene (DMA-DPH) into the blue-emitting PF we were able to enhance the PLED's emission intensity, especially at around 510 nm where the OPD has its absorption peak. In other devices we directly used the green-emitting PF copolymer instead of the blue dye dispersed homopolymer.

The input unit of the optocoupler was characterized by taking EL spectra and I-V-L curves, while for the PD I-V characteristic curves were recorded.

ABSTRACT: P II.38[A]

Photoresist material and process optimization for the patterning of biomolecules on functionalized surfaces

P. Pavli[1,3], M. Chatzichristidi[1], A. M. Douvas[1], P. S. Petrou[2], S.E. Kakabakos[2], D. Dimotikali[3], P. Argitis[1]*

[1]Institute of Microelectronics, NCSR "Demokritos", 15310 Athens, Greece
*argitis@imel.demokritos.gr
[2]Immunoassay-Immunosensors Laboratory, I/R-RP, NCSR "Demokritos", 15310 Athens, Greece
[3]Department of Chemical Engineering, National Technical University of Athens, 15780 Athens, Greece

A photoresist-based method has been introduced few years ago by our group for the patterning of biomolecules on solid surfaces. The photoresist developed has as basic components a (meth)acrylate tetrapolymer and a photoacid generator. In the present paper the resist material composition and the process conditions are further investigated to allow effective protein or oligonucleotide patterning in repeated lithographic cycles on functionalized substrates.

Protein patterning based on physisorption to plastic substrates or substrates covered by polymeric films or SAMs has been demonstrated. On the other hand the same strategy was used to bind oligonucleotides, e.g. by using streptavidin functionalized oligos which are deposited to substrates where biotinylated BSA has been physisorbed. Substrates functionalized with SAMs or thin polymeric films allowing chemical binding of proteins or oligonucleotides have also been investigated. The resist process results in certain cases in reduction of the chemical binding abilities of the functionalized surfaces. The influence of the functional group used and the resist process conditions are currently under investigation.

The chemical reactions taking place during the processing steps are followed in situ by FTIR and UV-Vis spectroscopy whereas the surface changes are monitored by contact angle and fluorescence spectroscopy. The presence of the hydroxyethyl group in the photoresist composition allows effective control of the resist material adhesion, homogeneity, sensitivity and capability for processing under biocompatible conditions but also results to undesired crosslinking reactions that have to be controlled in order to avoid lithographic performance deterioration. On the other hand the specific photoacid generator used influences both the development of the photoresist and the sensitivity. The monitoring of the photoacid generator chemical changes during the different process steps provides an effective way for the material and process optimization.

MICRO & NANO FABRICATION

ABSTRACT: P II.39

Colloidal lithography: comparison between thermal evaporation and RF sputtering

Ulmeanu Magdalena[1], Filipescu Mihaela [1], Medianu Rares [1]

[1]National Institute for Laser, Plasma and Radiation Physics, Laser Department, 077125 Magurele, Romania.

We use spherical polystyrene spheres in the size range from 60 nm - 5 µm to form lithografic masks on surfaces. The masks consist of hexagonally arranged monolayers of these particles. When a droplet of the colloidal suspension is placed on a substrate, the masks form independently via a self-organized process upon solvent evaporation. With the help of the so called floating technique, the masks can be transferred to almost any arbitrary substrate. They have been utilized e.g. as masks for vacuum deposition, ion etching, or as masters for micro-contact-printing. Current research concentrates on the structure differences when the film deposition was done by thermal evaporation or RF magnetron sputtering. Investigations have been done on different metallic films, lige Au, Ag and Ni. The structures were investigated by atomic force microscopy (AFM) and scanning force microscopy (SEM). The differences in the nanostructures obtained after the removal of the colloidal mask will be evaluated in respect with the thin film deposition technique.

ABSTRACT: P II.40

Dewetting of thin polymer films controlled by a simple energetic criterion

Ioannis Karapanagiotis

Ormylia Foundation, Ormylia Chalkidiki, 63700, Greece, e-mail: g.karapanagiotis@artdiagnosis.gr

Several strategies have been proposed to use thermal dewetting as a simple and low-cost surface-pattern process. All are based on a simple central idea: within a certain annealing time film rupturing (and therefore dewetting) must be promoted only at predetermined spots. Consequently, developing criteria that could assess the conditions in which predetermined spots of the polymer surface lead to film rupturing is of great importance.
In this work, a criterion is developed to predict the resulting evolution process of the following surface defects on thin polystyrene (PS) films on silicon (Si): (i) Nanoindentation induced indents which grow after being heated above the glass transition temperature of PS, T_g, leading to dewetting, (ii) nanoindentation induced indents which level at temperatures above the T_g, resulting in a flat polymer surface and (iii) indents which are formed and grow spontaneously by thermal treatment above the T_g (thermal film break up). The criterion is based on the concept of the excess surface energy, ΔF_γ, which is induced on an initially planar film upon defect formation. ΔF_γ measurements are based on Atomic Force Microscopy (AFM) images of the surface defects, collected prior to any thermal annealing above T_g. It is reported that growing depressions (cases i and iii) correspond to $\Delta F_\gamma > 1.5 \times 10^{-16}$ J while for healing depressions (case ii) $\Delta F_\gamma < 1.8 \times 10^{-16}$ J. A critical region of ΔF_γ exists from 1.5×10^{-16} to 1.8×10^{-16} J. Depressions which correspond to this, rather short, region can either grow or heal. Nevertheless, the results suggest that ΔF_γ can be used to predict the evolution process of a surface defect, regardless of its formation mechanism, with relatively good success. Consequently, ΔF_γ measurements can provide to the manufacturers the ability to initiate or prevent dewetting at specific spots, according to their will.

ABSTRACT: P II.41

Oxygen Plasma Development of Silylated Epoxydized photoresists for Micromachining Applications

D.Kontziampasis[1], E. Gogolides[1]

[1]Institute of Microelectronics, National Centre for Scientific Research, NCSR "Demokritos", P.O. Box 60228, Aghia Paraskevi, Attiki, Greece 15310.

Epoxydized photoresists (e.g. EPON® SU8) are widely used in micromachining applications for pattern transfer. Their main advantage is their capability of forming uniform thick films ranging from tens to hundreds of microns. Metallization is another important process used in micromachining and Lift-off is one method for selective metallization.

Epoxydized photoresists are negative-tone photoresists (exposed areas remain) because exposed areas are cross-linked since a photoacid generator (PAG) is mixed in their composition. The main problems of epoxydized resists are the following: (A) cross-linked materials cannot be stripped in conventional solvents (thus the resist is hard to remove after plasma etching of the substrate), (B) lift-off is impossible for the same reason as (A), and (C) the use of solvents during wet development may deform high aspect-ratio structures.

In this paper we propose a positive tone process for EPON® SU8, using liquid-phase silylation followed by O_2 plasma development for microstructure fabrication and lift-off. We expand our previous work on silylation of thin (<1μm) epoxidized resists[1,2] to thick (several tens of microns) films and demonstrate a) patterning b) stripping and metallization with this process. In our process silicon uptake by surface only silylation takes place in the non-exposed-non-crosslinked areas. In the subsequent O_2 plasma step, these areas are protected by being converted to SiO_2, while the crosslinked areas are etched away. Thus the process becomes positive tone. Use of solvents is avoided for the development (overcame problem (c)).

Stripping was easily achieved after plasma development with the use of acetone as a solvent in ultrasonic (within less than 30 seconds), while it was not possible for several tens of minutes for the same polymer when it was cross-linked after classical lithography (Thus we can overcome problem B above).We also demonstrated successful lift-off.

References:

1. E, Gogolides, E. Tegou, P.Argitis, M. Hatzakis, U.S. Pat., No 6,296,989, Oct. 2, 2001.
2. E. Tegou, Surface silylation: Chemistry and process issues (2001) J. of Photopolymer Science & Technol., 14 (3), pp. 495-502.

ABSTRACT: P II.42

VUV LASER CIRCULAR Microstructured Surface relief GRATINGS INDUCED on PTFEMA SURFACE

E. Sarantopoulou, Z. Kollia, A. C. Cefalas
National Hellenic Research Foundation. Theoretical and Physical Chemistry Institute
48 Vassileos Constantinou Avenue, Athens 11635 Greece

A. M. Douvas, M. Chatzichristidi, P. Argitis,
Institute of Microelectronics, NCSR Demokritos, 15310 Agia Paraskevi, Greece

Micro/nano structures on polymers are excellent templates and matrixes of metal and dielectric deposition for different applications. Microstructured circular surface relief gratings (SRG) induced by laser light at 157 nm on the fluoropolymer 2,2,2 poly trifluoroethyl methacrylate (PTFEMA), were obtained under well-controlled light exposure conditions. Under the specific experimental conditions, the SRG and self-organization patterning have their origin on the development of a surface thermal instability (Rayleigh's instability), which resolves itself into regular patterns of circular and hegagonal structures on the surface of the fluoropolymer. The thermal instability is due to the explosive polymer surface photo-dissociation at 157 nm and the build up of longitudinal and periodic surface stress, which eventually create the SRG and self-assembled structures on the polymer. A theoretical model explained the experimental results satisfactory.

ABSTRACT: P II.43

The nanoscience of the alloy liquid metal ion sources and application in focused ion beams

Theodore Ganetsos [1]

[1]T.E.I. of Lamia, Department of Electronics, 3rd Lm O.N.R. Lamia-Athens, Lamia, Greece, e-mail: ganetsos@teilam.gr

The liquid-metal ion source (LMIS) and the related liquid-alloy ion source (LAIS) produce optically bright beams of ions. At present, they are the brightest sources of ions in commercial use, and are used as the ion source in the Focused Ion Beam (FIB) machine and in other scientific tools. [1-4]
For special purposes like writing ion implantation or ion mixing in the micrometer- or sub-micrometer range different ion species are needed. Therefore alloy liquid metal ion sources (LMISs) are used. The energy distribution of the ions from an alloy LMIS is one of the determining factors for the performance of a FIB column. Different source materials like $Au_{73}Ge_{27}$, $Au_{82}Si_{18}$, $Au_{77}Ge_{14}Si_9$, $Co_{36}Nd_{64}$, $Er_{69}Ni_{31}$, $Ga_{38}Bi_{62}$, $In_{50}Ga_{50}$, $Sn_{86}Pb_{14}$ and $Er_{70}Fe_{22}Ni_5Cr_3$ were investigated with respect to the energy spread of the different ion species as a function of emission current, ion mass, charge state and emitter temperature and the abundance of the species, emitted from the tip, in the mass spectra.
Most of the alloy LMISs discussed above have been used in the Rossendorf FIB system IMSA-Orsay Physics especially for writing implantation to fabricate sub-micrometer pattern without any lithographic steps. A Co-FIB was applied for the ion beam synthesis of $CoSi_2$ micro-and nanostructures. Additionally, the possibility of varying the current density with the FIB by changing the pixel dwell time was used for radiation damage investigations in Si, Ge and SiC at elevated implantation temperatures. Furthermore, a broad spectrum of ions was employed to study the sputtering process depending on temperature, angle of incidence and ion mass on a couple of target materials using the volume-loss method as well as used for patterning of different surface structures, i.e. in nano-functional films. Especially this technique was used for the fabrication of various kinds of micro-tools.

References

[1] Prewett PD & Mair GLR (1991) Focused Ion Beams from Liquid Metal Ion Sources. Research Studies Press, Taunton, UK.
[2] Orloff J, Utlaut M & Swanson LW (2003) High Resolution Focused Ion Beams: FIB and its Applications. Kluwer Academic/ Plenum, New York.
[3] Giannuzzi LA & Stevie FA (Eds) (2005) Introduction to Focused Ion Beams. Springer, New York.
[4] Forbes RG (1997) Vacuum 48, 85.

ABSTRACT: P II.44

Dependence of the curvature of Si/Ge cantilevers on the size, composition, temperature

N. Skoulidis* and H.M. Polatoglou

Aristotle University of Thessaloniki, Greece

Mirrors are very important in controlling electromagnetic radiation, with applications such as radiation guiding, lithography, modulation, sensors and filtering. Especially in our days the needs of this control is concentrated in the micro and sub-micro scale. Therefore is necessary to study the possibilities of using new materials that could be used for the formation and the control of mirrors at that scale. Although for the micro scale a number of studies have presented, in the sub-micro scale only a few such studies have been performed and referenced in bibliography.
The aim of the present work is to study the possibilities of a sub-micro sized composite material to be used as an actuator for the control of a similarly sized mirror. The material we study is a Si/Ge cantilever measuring up to a few hundreds of nanometers. For this purpose we first create atomistic model structures and then we extract the structural properties of those models, using an empirical interatomic potential based model. This process is performed using an integrated windows based tool, called STREL, which has been developed for the study of structural, electronic energy states and optical properties of nanostructures.
The properties we study are the curvature of the cantilevers and its dependence on the size, composition and temperature. Also to compare we perform finite element analysis of the same structures. Analytical discussion of the effects of the various parameters on the curvature and the similarities and differences will be presented.

Keywords: Mirrors, sub-micro scale, curvature, cantilever.

ABSTRACT: P II.45

Electron Beam Lithography Simulation Algorithm over Multilayer Substrates

Nikolaos Tsikrikas[1], George P. Patsis[1], Ioannis Raptis[1]

Institute of Microelectronics, NCSR Demokritos, Athens, 15310 Greece,
e-mail: gpatsis@imel.demokritos.gr

Strong candidate lithography for the mass production of devices at the 32nm technology node and beyond is extreme ultra violet lithography (EUVL). One special characteristic of EUV masks is its composition (Mo/Si multilayer, absorbing layer, etc.) which is totally different from the conventional photomask. This has to be considered explicitly in the simulation of electron-beam energy dissipation calculation (EDF) using Monte Carlo methods [1]. So far the application of analytical methods is very difficult in the case of substrates more complex than resist/layer 1/layer 2/bulk layer [2].
In the current work the algorithms for the simulation of the e-beam over a complex multilayer substrate will be presented with simulation results obtained from coding them in the Matlab platform. Three-dimensional modeling of the electron beam interactions inside the material stack is used. The deposited energy calculation takes into account the location in the stack where scatterings took place, the material nature, and the type of scattering. The energy is deposited accordingly using the continue slowing down approximation utilizing the Rutherford differential cross section. On a more detailed level of analysis, the Monte Carlo procedure of Salvat and Parellada [3], is applied for the electron-beam energy deposition in a resist film covering a multi-layer of Mo/Si layers on top of a Si substrate. PMMA resist is assumed, on top of the multilayer the multi-layer. Hiroguchi's et al. method [4] was incorporated in order to correctly determine the mean free path of electron track due to multi-layer presence in the Mo/Si structure.
Techniques for the fast and accurate simulation will be presented. Problems originating from the convolution of the e-beam with an actual layout will be discussed and directions to their solution will be proposed.

1. B.Lu, J.R.Wasson, E.J.Weisbrod, Z.Masnyj, P.J.Mangat, et.al J. Vac. Sci. Technol. B20, 3029(2002)
2. I.Raptis, B.Nowotny, N.Glezos, M.Gentili, G.Meneghini Jpn. J. Appl. Phys. 39 635(2000)
3. F. Salvat, J. Parellada, J. Phys. D: Appl. Phys. 17, 185 (1984).
4. S. Horiguchi, M. Suzuki, T. Kobayashi, H. Yoshino, and Y. Sakakibara, Appl. Phys. Lett. 39(6), 512 (1981).

ABSTRACT: P II.46

Evaluation of polymers containing ketal or acetal groups in the backbone as candidate photoresist components

T. Manouras[1], A. M. Douvas[1], V.P. Vidali[2], M. Chatzichristidi[1], N. Vourdas[1], E. Gogolides[1], E.A. Couladouros[2], P. Argitis[1]

[1]Institute of Microelectronics, NCSR "Demokritos", 15310 Athens, Greece, *argitis@imel.demokritos.gr
[2]Institute of Physical Chemistry, NCSR "Demokritos" 153 10 Athens, Greece.

Backbone breaking chemistries are considered very attractive for high resolution, low Line Edge Roughness (LER) photoresist materials. The best known examples are provided by non-chemically amplified photoresists, mainly based on poly(methyl methacrylate) (PMMA). Nevertheless, these materials suffer in most cases from poor etch resistance to the plasmas used for pattern transfer and low sensitivity.
In the present paper we evaluate a new class of polymers as possible components of photoresists. The polymers contain ketal or acetal groups in their back bone, which can be easily broken in acidic environment, and a significant percentage of aromatic groups for etch resistance purposes. The polymers were in most cases synthesized following a route proposed by M. J. Heffernan and N. Murthy (Bioconjugate Chem. 2005, 16, 1340), which is based on acetal exchange reactions between a suitable diole and a precursor acetal containing molecule. Similar routes based on different acetal or ketal precursors have been also investigated. Chemical and physicochemical characterization has been carried out using mainly Nuclear Magnetic Resonance (NMR), Gel-Permeation Chromatography (GPC) and Differential Scanning Calorimetry (DSC).
The polymers have been evaluated as components of chemically amplified resist formulations along with photoacid generators upon exposure at 248 nm. The imaging chemistries have been investigated using mainly Fourier-transformed infrared (FTIR) and UV-Visible spectroscopy and the limitation posed by thermal and photochemical reactions have been identified. Acid catalysed imaging is dominant in a fairly broad processing conditions range. The influence of material and processing parameters on the lithographic performance and the etch resistance in plasmas used for pattern transfer will be discussed.

ABSTRACT: P II.47

Photoresist models for stochastic lithography

Dimitrios Drygiannakis[1], George P. Patsis1, Ioannis Raptis[1]

Institute of Microelectronics, NCSR Demokritos, Athens, 15310 Greece,
e-mail: gpatsis@imel.demokritos.gr

The minimum feature size for VLSI circuit geometry will reach 20nm in the upcoming 45nm technology node. In order to achieve this aggressive target, various new lithography technologies such as extreme-ultra-violet lithography are examined for mass production. The required accuracy of features should be within the size of one molecule. Therefore very detailed photoresist models are important to be developed and used in a process modeling framework of lithography simulation.
Experiments and simulations have shown that low-molecular-weight resist materials and ultimately molecular resists could result in low line-edge roughness (LER) which is a critical parameter for the accuracy control of the forthcoming technology nodes.
The purpose of the this work is to present algorithms used to model polymer chains of various degrees of polymerization and architectures as well as molecular resist architectures, both in two and three dimensions and propose methodologies for fast and accurate creation of material lattices that could be combined with other lithography input data such as energy deposition and resist dissolution algorithms, in order to result in detailed representation of resist edges, and eventually of the design layout.

DESIGN, INTEGRATION, SYSTEMS, PHOTONICS

ABSTRACT: P II.48

THICK MICROPOROUS SILICON ISOLATION LAYERS FOR INTEGRATED RF INDUCTORS

J. Semai[1], G. Gautier[1], P. Leduc[2] and L. Ventura[1]

[1]Université de Tours, Laboratoire de Microélectronique de Puissance, LMP-ST, 16 rue Pierre et Marie Curie, BP 7155 Tours France 37071
[2]ST Microelectronics, 16 rue Pierre et Marie Curie, 37071 Tours Cedex 2, France

The rapid expansion of wireless devices caused a tremendous demand on the development of active and passive devices integration on silicon. However, the bad electrical insulating properties of silicon make the integration of passive devices such as inductors or capacitors difficult. In the field of RF applications, porous silicon (PS), produced by silicon anodization in HF based solutions, has been proposed during a few years as a possible candidate [1]. Indeed, losses due to the underlying substrate can be significantly reduced by the low electrical conductivity, between 10^{-1} and 10^{-3} $S.m^{-1}$, and the low permittivity (3 to 9) of PS modulated by the porosity of the material [2].
Microporous silicon is known to be produced under specific conditions (wafer doping level and specific electrolytes). However, large microporous thicknesses suffer from mechanical stability problems mainly during the drying process.
In this work we study the implementation of thick microporous silicon layers on resistive P type wafers (30 – 50 Ω.cm) using particular mixtures based on HF-H_2O and acetic acid with various concentrations. Thus, PS layers with thicknesses up to 400 µm have been realized with a porosity of 50%. Depending on the electrolyte characteristics (concentration and composition) and current densities, porosities extending from 50 to 80% can be obtained.
In the present work, we also deal with the simulation of inductor electrical behaviour on porous silicon substrates using the commercial software HFSS. The impact of several process parameters, such as the porosity or the porous silicon layer thickness, on the quality factor of the devices is studied.

References:
[1] C. Nam and Y. Kwon, IEEE Microwave and Guided Wave Lett. 7, 236 (1997).
[2] H.S. Kim, K. Chong and Y. Xie, Phys. Stat. Sol. A 197, 269 (2003).

ABSTRACT: P II.49

SECS: A novel system for the design and simulation of single electron circuits

George T. Zardalidis

Faculty of Electrical and Computer Engineering, Democritus University of Thrace, Vas. Sofias 12, Greece, e-mail: gzardali@ee.duth.gr

A new nanoelectronic single electron circuit simulation system is presented in this paper. The fundamental phenomena that are lying behind the operation of nanoelectronic single electron circuits are the tunneling effect and the coulomb blockade effect. These two phenomena make possible the control of the discrete transfer and localization of single electrons or small numbers of electrons in nanoelectronic devices. The tunneling of single electrons is simulated with the Monte Carlo method where the change in free energy of the whole circuit determines tunnel rates of possible tunnel events. The novelty of the design and simulation system SECS is that it provides a real time transient simulation of arbitrary single electron circuits. The graphical environment provides great convenience for designing and manipulating large single electron circuits. The design and simulation of a single electron 2 to 4 decoder using the SECS system is also presented. We can conclude that the circuit of the decoder exhibits a stable operation according to the desired behavior. The low power consumption of the single electron 2 to 4 decoder is also verified by the simulation results.

ABSTRACT: P II.50

Alpha Particle Radiation Effects in RF-MEMS Switches

E. Papandreou[1], F. Giacomozi[2], G. J. Papaioannou[1] And B. Margesin[2]

[1] National Kapodistrian University of Athens, Solid State Physics Section of Physics Dpt., Panepistimiopolis Zografos, Athens 15784, Greece, e-mail: gpapaioan@phys.uoa.gr
[2] ITC- irst, Via Sommarive 18, 38050 Povo Trento, Italy, e-mail: giaco@itc.it

RF-MEMS capacitive switches and varactors receive increasing interest for space and a large variety of more or less hostile terrestrial applications. A particular area in space application is in picosats, where the radiation shield is minimal in order to reduce the satellite mass. In spite of this wide area of applications, the RF-MEMS switches commercialization is currently hindered by reliability problems, such as the charging of the dielectric. Presently, the available models assume that the dielectric charging arises from charges distributed throughout the dielectric material, the presence of charges at the dielectric interface and the injection of charges form the suspended bridge during ON-state.

In rad-hard environment the tests on MEMS accelerometers have shown the technology proneness to radiation effects at moderate dose levels. The reported radiation effects were attributed to electrostatic force caused by charge accumulation in the dielectric layers and a quantitative model for the electrostatic force was developed for some mechanical structure. Moreover, the effect of electron emission from the dielectric and injection into dielectric from the adjacent metallic electrodes and the resulting shift of the actuation voltage as a function of radiation dose play a significant role on the device performance degradation. Here it must be pointed out that no information on the charge kinetics during or after irradiation has been provided from these efforts.

The aim of the present work is to provide a deeper insight on the charge kinetics and the effect of the radiation induce ionization as well as the introduction of new defects and their result on the device performance. This has been achieved through the monitoring of the temperature effect on the charge kinetics before and after irradiation. Finally, the effect of the generated charge, during ionizing radiation, on the device performance has been examined.

ABSTRACT: P II.51

MEANDER: A CAD Tool Framework for Designing 2D/3D FPGAs

Kostas Siozios, Kostas Sotiriadis and Dimitrios Soudris

Electrical and Computer Engineering, Democritus University of Thrace, Vas. Sofias 12, Greece, e-mail: {ksiop, koststot, dsoudris}@ee.duth.gr

This paper introduces a new CAD tool framework, named *MEANDER*, targeting to design and implement applications onto 2D/3D FPGA devices. Based on its features, the proposed framework fulfilling both the needs of experienced designers by providing practical answers to state-of-the-art problems (*e.g.* logic synthesis, bitstream generation), and novice designers by providing a simple and consistent set of tools. To best of our knowledge, this toolset is the first complete framework in academia for mapping applications onto 2D/3D reconfigurable devices starting from a hardware description language (HDL) of the application and ending up to configuration file generation. It should me mentioned that the framework provides technology independence in order to allow designers to easily implement their applications in different process technologies, while it is easily extended in order to handle more advanced architectures (such as 3D Networks-on-Chip). The framework consists of a four CAD tools (synthesis, technology mapping, placement and routing (P&R), and configuration file generator). The first two of them are identical between the 2D and 3D toolsets, as they do not need to be aware of the third-dimensional FPGA topology. In other words, we reuse in the 3D design flow all those tools, which are independent of the target technology. Only the tools which are related with P&R and configuration file generation tasks should be replaced by the new tools, because they consider the particular traits of the 3D FPGAs, *i.e.*, technology platform dependent. The flow is Linux-based, while all the tools are open-source and available for on-line execution through the AMDREL's project website.

ABSTRACT: P II.52

Studying compatibilities between quantum cellular automata and Kane's semiconductor based quantum computer

D.Ntalaperas[(1,2)] and N.Konofaos[(1,3)]

[(1)] Computer Engineering and Informatics Dept., University of Patras, Greece
[(2)] Research Academic Computer Technology Institute, Patras, Greece.
[(3)] Department of Information and Communication Systems Engineering, University of the Aegean, Karlovassi, Samos, Greece.
e-mail: ntalaper@ceid.upatras.gr , nkonofao@aegean.gr

Quantum Computers are known for their ability to outperform classical ones in a variety of computational tasks. One of the most promising implementation techniques for a quantum computer is the one proposed by Kane, where a model for implementing a set of three Quantum Gates, known to be sufficient for universal computation was presented. According to this implementation scheme, quantum information can be encoded in the nuclear spin of phosphorous (P) donor atoms embedded in Si bulk material. Universal Computation however, can also be performed using Quantum Cellular Automata (QCA). In a recent work, it was demonstrated that by grouping two qubits in each automaton's cell and then letting only one of them to interact with the neighboring cells, universal computation can be performed. Moreover, it was also shown that a periodical behavior arises "naturally" in this scheme and that was demonstrated by simulation of the automata evolution with a set of given inputs.
The goal of our work is to combine these two methods by presenting an implementation of the Quantum Cellular Automata using Kane's model. In our work, we demonstrate the physics, we propose the model and the circuit and we calculate the error in computation. The amount of error due to decoherence is calculated as a function of the input size and a lower bound for that size is given for which the proposed circuit can calculate in an error free mode, provided that in our simulated system the decoherence times for a single qubit (t_φ) predicted by Kane are applied. The numerical values for $t_\varphi=10^3$ sec, and for the error fidelity $e=10^{-5}$, are within the limits of the values proposed by the Kane computer. Hence, in our case, compatibility between QCA and Kane implementation is shown to be feasible.

ABSTRACT: P II.53

QDIP technology and market prospects in the sectors of Defense, Environment, and Security

C. Charitidis[1*], A. Golnas[1,2], F. Chouliaras[1], N. Arpatzanis[3], C. A. Dimitriadis[3], J. I. Lee[4], C. Bakolias[5]

[1]School of Chemical Engineering, National Technical Univ. of Athens,15780 Athens, [*]charitidis@chemeng.ntua.gr
[2]1140 Pinemont Place, Annapolis, MD21403, USA
[3]Department of Physics, Aristotle University of Thessaloniki, 54124 Thessaloniki
[4]Nano Device Research Center, Korea Institute of Science and Technology, Seoul 136-791, Korea
[5] ZENON S.A. , Kanari 5 Glyka Nera, 15354

Quantum dots (QD) are a unique subset of nanomaterials characterized by their extraordinary quantum confinement behaviour. Even though the quantum dot industry is still in its infancy with revenues now reaching $10 million, it is expected to surpass $500 million in 2009. However, in order to leverage the full potential of the QD technology, new fabrication processes must be developed to attain high detectivity and high operating temperature (HOT) photodetector devices.
Very recently, mid- and far- infrared photodetectors based on self-assembled InGaAs quantum dots embedded in GaAs have been reported. In this case emphasis has been placed on the investigation of the Quantum Dot Infrared Photodetectors' (QDIP) trap properties with low-frequency noise measurements in the temperature range of 77-300 K, on their stability under dc bias voltage or constant-current electrical stress, and on the device simulation in order to examine the effect of the QD-induced traps on the device performance. Furthermore, the stability of the QDs after dc bias voltage application and constant current electrical stress was studied by monitoring the changes in their electrical properties and photoluminescence efficiency. The results reveal the impact of the QDs on the leakage current and the noise properties and give insight into the conduction mechanism of the reverse-biased Schottky diodes. The QDIPs possess an immense potential for civilian and military applications due to the distinct characteristics stemming from their dimensionality – which provides 3D carrier confinement and the capacity for normal-incidence detection – and their amenability to bandgap engineering – which allows tailoring the peak and cutoff wavelengths according to custom needs. The QDIPs, especially when optimized to operate at higher temperatures, can become critical components in optical communication, quantum computing and cryptography, and medical imaging applications. Robust and reliable solutions for these fields will command a premium position in the marketplace as by responding to the societal need for secure electronic transactions, exponentially faster data processing, and higher quality diagnostic tools.

ABSTRACT: P II.54

A thermal vacuum detector fabricated by a combination of MEMS and PCB technologies

A. Petropoulos[1], G. Kaltsas[2,1], A. G. Nassiopoulou[1]

[1]Institute of Microelectronics, NCSR-"Demokritos", Athens, GREECE, e-mail: tpetro@imel.demokritos.gr
[2]Department of Electronics, TEI of Athens, Aegaleo, GREECE, e-mail: G.Kaltsas@ee.teiath.gr

The exploitation of heat transfer as the mean to detect vacuum is a common method, reported throughout the literature. This work presents a thermal vacuum sensor fabricated directly on organic substrates. The heating element is a thin platinum film which is in direct electrical contact to the copper tracks of a PCB, while it lies on the upper surface of a 15μm thick SU-8 layer. Upon the passing of electrical current through the Pt resistor, an elevated temperature field is generated in the heater vicinity due to Joule heating. The temperature value depends on the rate that the heat is dissipated from the heater which in turn is a function of the pressure dependent thermal conductivity of the surrounding air environment. Therefore, by monitoring the temperature dependent resistance variation of the heater, information regarding the value of the vacuum field can be extracted. Since the device is comprised of polymeric materials which exhibit low thermal conductivity values (0.2 W/m·K), the heat dissipation to the substrate is significantly reduced. Therefore the corresponding device sensitivity increases as well as the range of the detected pressure values. A special experimental set-up was used, which consists mainly of a chamber where predefined pressure values were applied. Measurements were conducted in the region 1 atm - $1.8\cdot10^{-2}$ mbar and sensitivities up to 1.7Ω/mbar were extracted. The alternative operating mode of monitoring the power generated at the heater as a function of the vacuum while the heater is kept at a constant temperature is expected to provide a signal of higher sensitivity, as the effect of the air thermal conductivity temperature dependence will be suppressed.

Acknowledgements
This work is co-funded by 75% from the E.E. and 25% from the Greek Government under the framework of the Education and Initial Vocational Training Program-Archimedes and PENED.

ABSTRACT: P II.55

Fabrication and evaluation of a gas flow sensor, implemented on organic substrates by a novel integration technology

A. Petropoulos[1], G. Kaltsas[2,1], A. G. Nassiopoulou[1]

[1]Institute of Microelectronics, NCSR-"Demokritos", Athens, GREECE, e-mail: tpetro@imel.demokritos.gr
[2]Department of Electronics, TEI of Athens, Aegaleo, GREECE, e-mail: G.Kaltsas@ee.teiath.gr

A large number of silicon-based thermal flow sensors has been presented in the literature. In this work a novel thermal gas flow sensor fabricated directly on organic substrate, by utilizing a combination of PCB and MEMS techniques is presented. The device consists of two temperature sensing elements situated symmetrically on both sides of a heater. The sensing elements are temperature dependent thin platinum strips, which are in direct electrical contact to the pre-defined copper tracks of a PCB. A thick intermediate layer utilized by the negative photoresist SU-8 on top of the patterned PCB, planarizes the rough topology of the FR4 surface. The main advantages of this technology is the direct connection of the sensing element to the macroworld without the need of wire bonding, the planar surface of the sensor which poses minimal obstacle to the fluid flow and the elimination of die bonding and cutting, which are necessary process steps to silicon-based devices. Furthermore, since the sensor is mainly fabricated by organic materials which exhibit very low thermal conductivity (~0.2 W/m·K), the heat dissipation to the substrate is significantly limited, therefore increasing the device sensitivity.
The fabricated sensor is able to operate in both hot wire and calorimetric mode. Measurements of nitrogen flow, for flow rate up to 100SLPM, which corresponds to Reynolds numbers up to 25000, have been conducted in tubes of varying crossectional area. A special computer interface developed in the Labview environment is utilized in order to maintain a constant heater resistance value. The variation of the difference ΔR between the sensing resistors is a monotonous function of the flow rate. Similar behavior was found for the power dissipated at the heater P_h throughout the entire region. The maximum sensitivity was extracted at the low flow rate region (0-1 SLPM).

Acknowledgements
This work is co-funded by 75% from the E.E. and 25% from the Greek Government under the framework of the Education and Initial Vocational Training Program-Archimedes and PENED.

ABSTRACT: P II.56

Copper Wires in Macroporous Si Template for Microchannel Heat Sink Technology

F. Zacharatos and A. G. Nassiopoulou

IMEL/NCSR Demokritos, P.O. Box 60228, 15310 Athens, Greece

Thermal management in ICs becomes essential as integration density and total power consumption increase. The use of microchannels in high power density electronics cooling is a well-known technique for heat transfer [1]. In this work we developed Cu-filled macroporous Si channels which may be used as heat sinks in high power density electronics cooling. Macroporous Si is formed by electrochemical dissolution of bulk Si. Pore filling with copper is achieved by electrodeposition. The developed technology consists in the following: a) macroporous silicon layers with a microcavity underneath are formed in a two step electrochemical process b) copper is grown within the pores by electrodeposition thus resulting in a fabricated composite material which is appropriate for use as a heat sink on Si. The surface area of the microchannel heat sink is defined by patterning. Macropores are either randomly distributed or arranged in two-dimensional (2-D) arrays on the silicon surface. In this second case pore initiation pits are formed on the surface before anodization. These pits are arrays composed of inverted pyramids fabricated by a combination of lithography and anisotropic silicon etching. The pore size in this work was 5μm [2]. The ordered porous layer and the cavity underneath had a thickness of 40 μm each. Both the macropores and the cavity were completely filled with copper during a single electrochemical process. As described above, deep pore filling is achieved if the electrodeposition starts at the bottom of each pore and is forced to grow laterally while no nucleation takes place on the pore walls. If appropriate conditions are met, homogeneous copper wires can be fabricated. Copper filling of the microcavity underneath the porous layer is achieved by linearly increasing the applied potential. The fabricated structure is a Cu/Si composite material which is very appropriate for improved heat transfer behavior compared to bulk silicon.

[1] D. N. Pagonis and A.G. Nassiopoulou, Phys. Stat. sol. (a) 204, No.5, 1335-1339 (2007)
[2] D. N. Pagonis and A.G. Nassiopoulou, Microelectron. Eng. 83, 1421 (2006)

ABSTRACT: P II.57

Design and simulation of a CMUT array

V. G. Chouvardas*, M.K. Hatalis

Department of Informatics, Aristotle University of Thessaloniki, GR-54124 Thessaloniki, Greece

Ultrasound transducers and transducer arrays have been used in a variety of applications like NDT or medical imaging and therapy. The arrays are used for transmission or detection of ultrasonic beams. In transmission mode they are used as phased arrays which can do beam forming and beam focusing. Capacitive Micromachined Ultrasonic Transducers (CMUTs) have been only recently introduced in transducer arrays due to advances in micromachining technology.
In this paper we present the numerical simulation and design of a CMUT device and a CMUT phased array. The simulation is done using the Finite Element method and ANSYS software. The modelling and design is based on surface micromachining technology PolyMUMPS from MEMSCAP.

REFERENCES

[1] Two dimensional ultrasound phased array design for tissue ablation for treatment of benign prostatic hyperplasia. K.Y. SALEH and N.B. SMITH, INT. J. HYPERTHERMIA , VOL 20, NO. 1 (FEBRUARY 2004), pp. 7-31
[2] Steerable frequency-invariant beamforming for arbitrary arrays, Lucas C. Para, J. Acoust. Soc. Am., 119 (6), June 2006, pp.3839-3846
[3] Experiments in Ultrasonic Flaw Detection using a MEMS Transducer, Akash Jain, David W. Greve, Irving J. Openheim, Proceedings of SPIE, vol. 5057, pp. 431-439, 2003.
[4] Coupling of MEMS ultrasonic transducers, D.W. Greve, I.J. Openheim, Proceedings of IEEE Sensors, Vol. 2, 2003.
[5] Beamforming by means of 2D phased ultrasonic arrays, R. Kazys, L. Jakevicious, L. Mazeika, ISSN 1392-2114 ULTRAGARSAS, Nr.1(29), 1998, pp12-14.
[6] Finite element Modeling of CMUTs Using A Perfectly Matched Layer for Fast Simulation, Aygan Bozkurt, IEEE 2003 ULTRASONICS SYMPOSIUM.

ABSTRACT: P II.58

Design and simulation of a Micro-Mixer, based on MLG T-Flip-Flops and AC Electro-Osmosis

T. Tsenis, V. G. Chouvardas*, M.K. Hatalis

Department of Informatics, Aristotle University of Thessaloniki, GR-54124 Thessaloniki, Greece

In this paper we describe the design and simulation of a Micro-Mixer. The device is based on Magnetic Logic Gates (MLG) T-Flip-Flops which induced AC Electro-Osmosis. Using a magnetic wave (with fully controlled frequency and magnetization strength) an AC electro-osmotic field is created. This field is capable of producing vortices which help mixing substances. The magnetic wave is produced by MLG field-coupled permalloy T-flip-flops which are all connected in series by field-coupled magnetic nanowires. The design and simulation of the device, is presented and also a theoretical diagram of a magnetic micropump based on this same concept is introduced.

REFERENCES

[1] Simulation of Field Coupled Computing Architectures Based on Magnetic Dot Arrays. GYO¨RGY CSABA AND WOLFGANG POROD (Journal of Computational Electronics 1: 87–91, 2002).
[2] Nanomagnetic structures at surfaces. Hans Peter Oepen, Ju¨rgen Kirschner. (Current Opinion in Solid State and Materials Science 4 (1999) 217–221).
[3] Signal Processing with Coupled Ferromagnetic Dots. G.Csaba, A.Imre, G.H.Berstein, W.Porod, V.Metlushko. (IEEE-NANO August 26, 2002).
[4] Power Dissipation in Nanomagnetic Logic Devices. G. Csaba, P. Lugli, W. Porod. (2004 4th IEEE Conference on Nanotechnology).
[3] Nanocomputing by Field-Coupled Nanomagnets. György Csaba, Alexandra Imre, Gary. H. Bernstein, Wolfgang Porod and Vitali Metlushko. (IEEE TRANSACTIONS ON NANOTECHNOLOGY, VOL. 1, NO. 4, DECEMBER 2002).
[5] A new electro-osmotic pump based on silica monoliths. Ping Wang, Zilin Chen, Hsueh-Chia Chang. (Sensors and Actuators B 113 (2006) 500–509)
[6] AC electro-osmotic mixing induced by non-contact external electrodes. Shau-Chun Wang,Hsiao-Ping Chena, Chia-Yu Lee, Chun-Ching Yu, Hsueh-Chia Chang. (Biosensors and Bioelectronics 22 (2006) 563–567).
[7] On the Debye-Huckel Approximation in Electroosmotic Flow in Micro- and Nano-channels. A. T. Conlisk. (3rd Theoretical Fluid Mechanics Meeting 24-26 June 2002, St. Louis, Missouri)
[8] Electro-osmotic pumping on application of phase-shifted signals to interdigitated electrodes. Brian P. Cahilla, Laura J. Heydermanb, Jens Gobrechtb, Andreas Stemmera. (Sensors and Actuators B 110 (2005) 157–163).
[9] Fabrication of microfluidic devices for AC electrokinetic fluid Pumping. V. Studera, A. Pe´pina, Y. Chena , A. Ajdarib. (Microelectronic Engineering 61–62 (2002) 915–920).
[10] The effect of step height on the performance of three-dimensional ac electro-osmotic microfluidic pumps. John Paul Urbanski, Jeremy A. Levitan, Damian N. Burch, Todd Thorsen, Martin Z. Bazant .(Journal of Colloid and Interface Science 309 (2007) 332–341).

ABSTRACT: P II.59

Dielectric Characterization of Macroporous Silicon Thick Layers For Use As Capacitors In High Voltage Application

M. Theodoropoulou[1], D. N. Pagonis[1], A. G. Nassiopoulou[1],
[1]IMEL/NCSR Demokritos, Terma Patriarhou Grigoriou, Aghia Paraskevi, 15310 Athens, Greece

C. A. Krontiras[2], S. N. Georga[2]
[2]Depertment of Physics, University of Patras, Patras 26504, Greece, mtheodo@imel.demokritos.gr

Macroporous silicon composed of cylindrical macropores perpendicular to the surface was fabricated on selected areas on P+ silicon substrates (resistivity: 5mOhm.cm) by anodization in HF x Ethanol solution (40%-60% in volume) at a current density of 20 mA/cm^2. The thickness of the macroporous layer was 10μm. The samples were oxidized at high temperature in N_2 ambient in order to form SiO_2 of 20, 40 and 72 nm on pore walls and sample surface. MOS capacitors with Al metallization were then fabricated and the samples were characterized by dielectric spectroscopy (DS) in the frequency range 1Hz - 1MHz and in the temperature range 263 - 353K. The results reveal that at low temperatures the dielectric constant ε΄ is independent of frequency (t_{ox}=20nm ε΄~ 4.3, t_{ox}=40nm ε΄~3.0, t_{ox}=72nm ε΄~ 2.6). Above a certain temperature, the dielectric constant increases versus temperature in the low frequency region. This behavior is attributed to the contribution of space charge carriers to total dielectric response. A theoretical model, which calculates the static dielectric constant of the samples, is proposed. The calculated theoretical values are in good agreement with the experimental ones. Dielectric loss data show that the oxidized samples exhibit values of tanδ <10^{-2} which are smaller than those of the non oxidized samples. Impedance analysis was also performed. It was found that the electrical conduction of the oxidized samples is dominated mainly by the bulk. In the contrary, film-electrode interfacial phenomena contribute to the electrical conduction of non oxidized samples. Equivalent RC circuit analysis was performed in order to simulate the impedance response of all samples. The obtained dielectric characteristics enable oxidized macroporous silicon thick layers to be good candidates as capacitor dielectrics in high voltage applications.

ABSTRACT: P II.60

Flexible Organic Light Emitting Diodes (OLEDs) based on blue emitting polymers

M. Vasilopoulou[1*], A. Botsialas[1], D. Georgiadou[1], L. Palilis[1], P. Bayiati[1], N. Vourdas[1], P. S. Petrou[2], G. Pistolis[3], P. Argitis[1]

[1]Institute of Microelectronics, NCSR "Demokritos", 15310 Athens, Greece, *mariva@imel.demokritos.gr
[2]Immunoassay Laboratory, I/R-RP, NCSR "Demokritos", 15310 Athens, Greece
[3]Institute of Physical Chemistry, NCSR "Demokritos" 153 10 Athens, Greece.

Organic light emitting diodes (OLEDs) are currently under active research due to their applications in flat panel displays and solid state lighting. Whether for displays or lighting, billboards or posters and signaling, the big breakthrough in OLEDs comes when they can be thin and flexible yet give all colors at high brightness levels with long life.
In the present paper different colour flexible OLEDs were demonstrated using suitable emitters dispersed in a blue highly efficient electroluminescent poly(fluorenyl) (PF).
The flexible electroluminescent devices were fabricated on Indium Tin Oxide (ITO) coated polyethylene terephthalate (PET) substrates. The PET substrates with ITO coating had a sheet resistance of 35 Ω per sq. cm. Before deposition of organic layers they were cleaned by sequential rinsing in de-ionized water, acetone and isopropyl alcohol for 10 min in ultrasonic baths, dried in a vacuum oven for 2 h at 60 °C and then treated by O_2 plasma for 5 min. A 40 nm thick film of PEDOT-PSS was spin coated on top of ITO layer to improve hole injection and substrate smoothness and then the emitting layer was spin coated. Aluminum cathode electrodes of 300 nm thickness were deposited on top of the emitting layer by vacuum evaporation. The emitting layer was based on the blue emitting Poly[9,9-di-(2'-ethylhexyl)fluorenyl-2,7-diyl] (PF). For different colour light emitting devices suitable emitters were dispersed into the polymer matrix in suitable quantities. The selection of the emitters is based on their capability to be effective energy transfer acceptors from the blue emitting contucting PF. In particular, green OLEDS were demonstrated based on PF containing the emitter 1-[4-(dimethylamino)phenyl]-6-phenylhexa-1,3,5,-triene (DMA-DPH), whereas in red OLEDs the emitter (4-dimethylamino-4'-nitrostilbene) (DANS) was dispersed into the polymer matrix. In this way highly efficient blue, green and red flexible OLEDs based on blue emitting PF were demonstrated. Intermediate colours and white light can also be obtained by mixing both emitters in suitable concentrations.

ABSTRACT: P II.61

A real time development of an automatic fingerprint identification system using the AFS860 sensor and the C6713 DSP processor

C. Tselios, E. N .Zois, N. A. Livanos and A. Nassiopoulos

Research and Development Telecommunications Laboratory, Electronics Eng. Dept., Technological and Educational Institution of Athens, Ag Spiridonos and Palikaridou, 12210, Aegaleo, Greece.

In this work we developed and implemented an efficient fingerprint pre-process algorithm using the TMS320C6713 DSP starter kit (DSK) module, along with the Authentec AFS 8600 fingerprint sensor [1]. The system has been designed in order to provide a friendly user environment for financial and high security transactions along with minimal user intervention. The database used forty people by enrolling 20 images of their fingerprints using the sensor. Every image had 96x96 pixels at a 250 ppi resolution and at 8-bit gray level. The sensor postulates emerged from the theory of the Electric Field technology. Image processing was performed by custom developed software using both C and Matlab. Images were first subjected to a frequency and orientation processing. That was achieved using gabor-based filters that provided an image with best quality. This time-consuming processing has been optimized using a number of ad-hoc numeric procedures and it has been implemented to the DSP system. A method has been then developed in order to extract the critical parameters of the fingerprint image which provides the feature. A grid, centered at the core point of the image, has been applied to the fingerprint image in order to derive local information. Finally, classification algorithms were developed, including training as well as evaluating phase. The similarity measure was employed apart using either the Euclidean distance or, in few cases, the Mahalanobis distance. The type of classifier used was the Bayesian one along with the k-nearest neighbour. Using the above method, an identification accuracy of 90% was achieved, which is comparable to that obtained by other procedures in the literature [2].

References

1. AFS8600 Fingerprint Sensor Daughtercard Technical Reference. Authentec Inc, 2004.
2. A. Jain, L. Hong, and S. Pankanti, Filterbank Based Fingerprint Matching, IEEE Trans. On Image Processing, Vol. 9, No. 5, pp. 849-856, 2000.

ABSTRACT: P II.62

Energy Dissipation of Hot Electrons via Emission of Stretching Phonons in Semiconducting Carbon Nanotubes

Margarita Tsaousidou[1]

[1]Materials Science Department, University of Patras, Patras 26 504, Greece, e-mail: rtsaous@upatras.gr

The study of hot electron properties provides significant information about the electron-phonon coupling in low-dimensional semiconductors [1]. In the present work we calculate the power loss, P, of hot 1D electrons in semiconducting single-wall carbon nanotubes (SWCNTs). We restrict our interest at low temperatures where the energy dissipation is dominated by the emission of stretching phonons. P is calculated by using Fermi's golden rule. We consider electron intrasubband scattering within the lowest energy subband. The electron-phonon (*e-p*) interaction is described via a deformation potential. In the long-wavelength limit we obtain simple expressions for the matrix elements of the *e-p* coupling.

Numerical calculations of P as a function of the electron temperature are performed in the temperature range $1<T<70$ K for various values of the nanotube radius R. We also investigate the dependence of P on the electron density. Screening effects are taken into account. We find that screening reduces significantly the strength of the *e-p* interaction and, consequently, the magnitude of P. The effect becomes stronger with the decrease of R. We also derive an analytical approximate expression for the energy loss rate. We find that P is proportional to $\exp(-\hbar\omega_s/K_BT)$ where ω_s is the stretching phonon frequency for $q=2k_F$ (q is the phonon wave number and k_F is the Fermi wave number). Numerical calculations validate our approximate expression for P in a wide temperature range. These results could be particularly useful for steady-state electric field heating or time-dependent experiments [2] where the comparison with the experimental data will provide significant information about the *e-p* coupling in semiconducting SWCNTs.

[1] See for example, R. Fletcher, V.M. Pudalov, Y. Feng, M. Tsaousidou and P.N. Butcher, Phys. Rev. B 56, 12422 (1997).
[2] T. Hertel and G. Moos, Phys. Rev. Lett. 84, 5002 (2000).