

**PROJECT I.1 FUNCTIONAL MOLECULAR MATERIALS
FOR LITHOGRAPHY AND ORGANIC/MOLECULAR ELECTRONICS**

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Research orientation

a. Optimization of lithographic materials and patterning processes - Development of new resists for high resolution, low LER lithography

Current activities include resists based on polymer back-bone breaking, resists based on unconventional imaging approaches, and experimental/simulation studies for supporting material and process optimization.

b. Lithographic materials and processes for micro-nano structure fabrication in MEMs and Nano-biotechnology

Investigation of material and process issues related to conventional and novel lithographic schemes proposed for patterning in the areas of MEMs, bio-MEMs and related fields

c. Materials research for organic/molecular electronics

Materials research and device architecture studies for molecular/organic electronics. Current activities include materials for molecular memories, organic light emitting diodes (OLEDs), photovoltaics and new optoelectronic devices.

Funding

- **Nano2Life**, EU FP6 Network of Excellence (NMP), 2004-2008
- **GSRT-PENED 03ED276**, "Critical sub-100nm Industrial scale Patterns for CMOS – NANO Architectures, (CMOS-NANO), 2005-2008
- **GSRT-NON-EU 467**, "Proton Beam NANOLithography for high aspect ratio structures of optical COMPONENTs" (PB.NANOCOMP), 2006-2008

MAIN RESULTS IN 2008

a. Optimization of lithographic materials and patterning processes – Development of new resists for high resolution, low LER lithography

E-beam and Proton-beam lithography simulation for the patterning of high resolution structures

Several alternative lithographic technologies have been suggested as potential candidates for the mass-production of integrated circuits in the next technology nodes (22nm and beyond) such as nanoimprint lithography, interference lithography etc. One of those technologies is the Mask-Less Electron Beam Lithography (ML-EBL). One of the very recent approaches in this area is the application of a shaped beam through Patterned Beam Defining Aperture (3rd-order imaging approach). The effect of beam edge acuity on resolution and LER of that particular approach is reported.

A 3D accurate electron beam matter interaction model is combined with a detailed material stochastic simulation for the simulation of e-beam edge. The particular EBL simulator is capable to handle multi-layer substrates, a feature very important in the case of direct writing.

The energy deposited (EDF) from a point beam is calculated by a Monte Carlo module. The EDF is then convoluted with the beam used for the actual writing either with trapezoidal or Gaussian profile (Fig. 1). The resulted convoluted EDF is used as input in the stochastic simulation module, which models in detail the polymer chains in the resist film, photoacid generator (PAG) initiation, acid diffusion, and finally resist dissolution. This way it is possible to simulate the LER and correlate it with the edge acuity of the original beam profile. Fig. 2a, shows a 45nm square pattern simulated with the trapezoidal (left) and the rectangular beam (right). The initiate PAG concentration, and the resulted shape of the square after resist dissolution in the case of a resist film consisting of linear, or randomly grafted chains are also shown in Fig. 2. Measuring LER on the final resist edges results in the LER values shown in Fig. 3, while the corresponding average CDs are shown in Fig. 4. These quantitative graphs indicate that indeed increasing edge acuity decreased LER and improved nominal CD replication on the printed pattern.

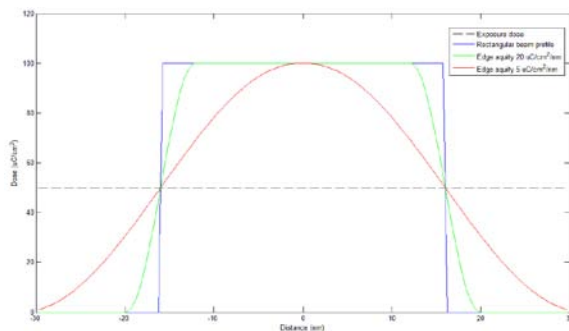


Fig. 1. E-beam Simulation with rectangular, trapezoidal, or Gaussian beam. All functions have the same maximum dose and the same full-width-half-maximum.



Fig. 2. Grafted and linear chains with 20 monomers / chain, Monomer radius= 0.5nm. Holes nominal CD= 45nm. EDF is determined from 3D Monte Carlo simulation and with convolution with the trapezoidal or the rectangular function.

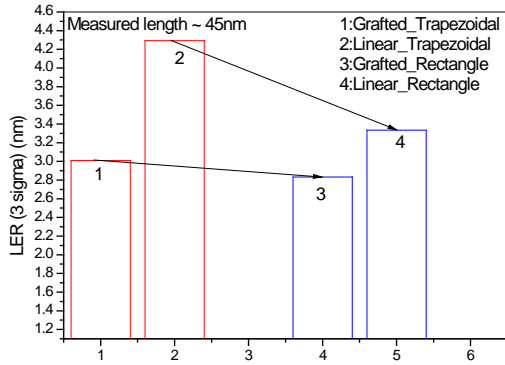


Fig. 3. E-beam Simulation with Trapezoidal and Rectangular Beam Shape. LER decreases with increasing edge acuity especially for linear chains.

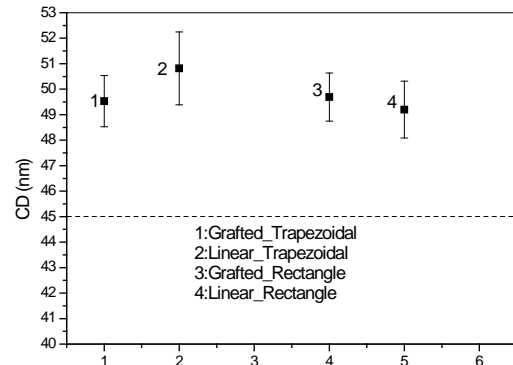


Fig. 4. E-beam Simulation with Trapezoidal and Rectangular Beam Shape. CD accuracy improves with increasing edge acuity (cases 3,4).

The e-beam lithography simulation approach described above was applied also for the simulation of Proton Beam Writing (PBW), a promising high resolution lithographic technology. For the PBW simulation, a complete model of proton energy transfer from a proton beam to a photoresist film was developed.

By applying the simulation software presented in the previous section, the PBW interaction with matter was explored. In Fig. 5 the energy deposition vs. sample's depth, due to point PB exposure, for 18 μ m PMMA film thickness is illustrated. The limited energy deposition dependence of the energy deposition with the resist depth (increased by 17% only) is one of the advantages of the PBW over the EBL for the patterning of thick films. In Fig. 6 the energy deposition vs. lateral dimension for various resist depths is presented. It is clear that the beam broadening is very small regardless the very high film thicknesses and certainly is considerably smaller compared to the broadening in EBL. This limited beam broadening is the second advantage of the PBW over the EBL for thick resist film patterning. These two advantages make the PBW the ideal approach for mask-less patterning of high aspect ratio structures limited only by the initial proton beam diameter and the ability of the resist material to withstand high aspect ratio structures. In fig. 7 the energy deposited, cross-section, for a line exposure is illustrated, while in Fig.8 the actually negligible proximity effect is proven for a layout including a cross pattern. In the EBL case, the proximity would cause significant deviations of the resulted trenchwidth over the whole line length.

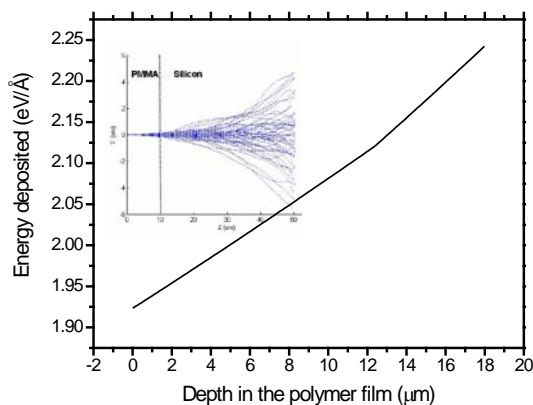


Fig. 5 The energy deposition vs. resist depth, using our Monte - Carlo simulations for 2 MeV protons impinging into 18 μ m PMMA film on Si substrate.

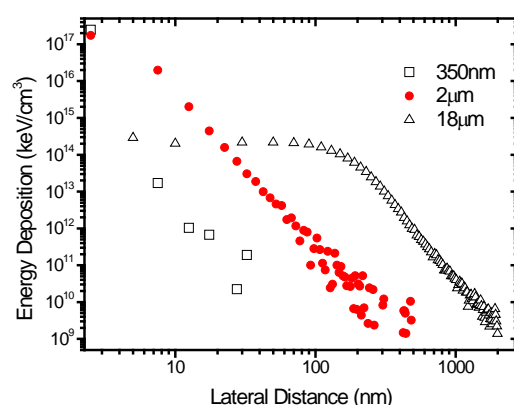


Fig. 6 The energy deposition vs. lateral dimension for various PMMA resist films (350nm, 2 μ m and 18 μ m) at the resist/Si interface. The beam broadening is very small regardless the very high film thicknesses.

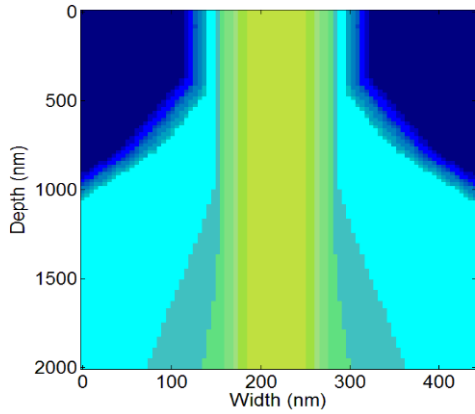


Fig. 7. Energy deposition profile (cross-section) for a 40nm wide line exposed with a beam of 100nm diameter.

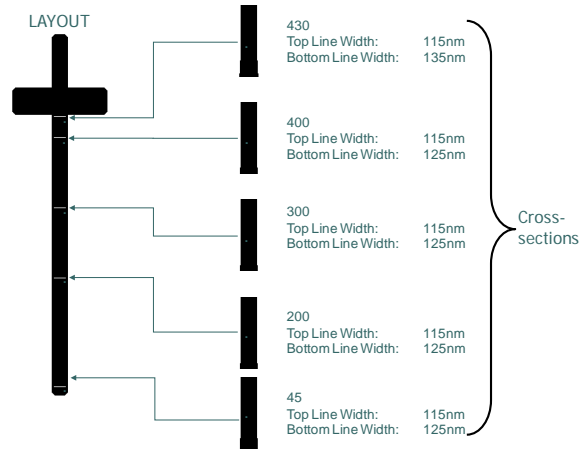


Fig. 8: Absence of proximity effect in PBW

Processing effects on the dissolution properties of thin chemically amplified photoresist films

Resist film thickness is anticipated to be 60 nm in the 22 nm technology node setting significant processing challenges due to resist non-bulk behavior. The changes in the dissolution rate of a commercial positive DUV polymer based chemically amplified resist platform due to various processing conditions such as film thickness, exposure dose, and thermal processing conditions, was experimentally investigated. It was quantified among others, the way an increase of PAB temperature deteriorates dissolution rate at low exposure dose, while in higher exposure doses increasing PAB temperature enhances dissolution rate. Also, an analytic model for the dissolution rate was imported on a stochastic lithography simulator and first quantitative results for thin films are reported.

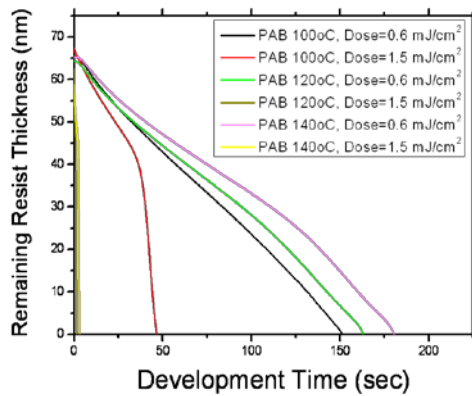


Fig. 9: Film thickness evolution of 65nm thick AZ6270 films, processed at various PAB conditions, for two exposure doses (low and high)

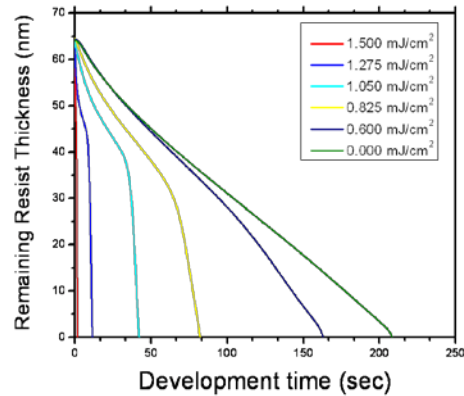


Fig. 10: Film thickness evolution of 65nm thick AZ6270 (AZ-EM) films for a wide exposure dose range. Unexposed films are dissolved smoothly with a low Dissolution Rate (DR). At high doses, two DR are observed.

A new imaging approach based on a thermally developable, etch resistant molecular material

A new imaging approach that is allowed by molecules with certain molecular structure characteristics as the 1,8 Naphthalenedimethanol (Fig.11) was introduced by our group. This molecule is soluble and can form films by spin coating, although it is also suitable for vacuum deposition. It was found that in the presence of a photoacid generator and after exposure in the 248 nm area (exposure at 193 nm is also possible) the sublimation temperature changes dramatically as shown in Fig. 12.

The proposed mechanism and the imaging principle are also shown in Fig. 11. In acidic environment 1,8 Naphthalan is created by the cyclization of 1,8 Naphthalenedimethanol [1]. The produced 1, 8 Naphthalan has lower sublimation temperature than the 1,8 Naphthalenedimethanol so that in the PEB step only the exposed area is developed. In figure 12, IR spectra for the 1,8 Naphthalenedimethanol without and with addition of PAG are presented. We can follow the sublimation of the initial diol by the dramatic reduction of all the peaks in the IR spectrum. In the left spectrum, this reduction occurs at ~ 150 °C but after the addition of PAG and exposure, the reduction occurs at ~ 60 °C. The produced chemical compound (ether) is indeed expected to have a distinctly lower sublimation temperature than the initial diol, due to the dramatic reduction of the intermolecular bonding.

1,8 Naphthalenedimethanol-based films showed very good etch resistance performance as expected by the high aromatic content of the compound. In this respect it seems that there is improvement in comparison with other thermally developable systems studied in the past. It should also be noticed the close structural resemblance of the studied molecule with the currently investigated polyaromatic compounds in the field of organic electronics suggesting that this approach may find applications in patterning schemes for this area as well.

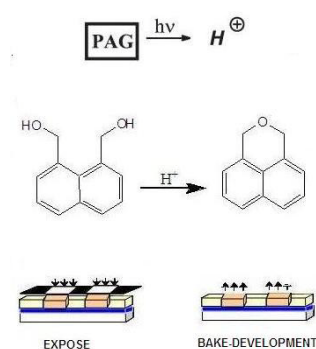


Fig. 11. Imaging Principle. The initial 1,8 Naphthalenedimethanol has distinctly higher sublimation temperature (~150 °C) compared with the produced 1,8 Naphthalan (~60 °C)

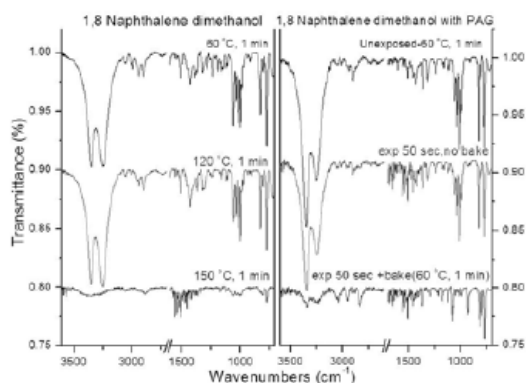


Fig 12. IR spectra for several temperatures. Left: Films without PAG, Right: Films with PAG.

b. Lithographic materials and processes for micro-nano structure fabrication in MEMs and Nano-biotechnology

Photolithographic approaches in bio-surfaces functionalization

The chemical binding of biotin derivatives on patterned epoxy resist (EPR), which was first proposed by our group last year, has been further advanced. The epoxy resist used is a high resolution material that can be applied for the fabrication of submicron structures with deep UV

exposure but has been also proved capable for sub 100 nm lithography if a suitable form of radiation, for instance e-beam, is used. The innovative aspect in this method relies in the fact that the epoxy resist is used for the creation of the micro structures and at the same time as substrate for covalent binding of biomolecules. The important factor of the proposed process is to tune the lithographic performance of the resist while keeping its chemical binding capacity in order to achieve the maximum resolution and the highest binding performance.

Unmodified biotin and biotin derivatives have been tested for binding on unexposed resist and on resist exposed at different doses. The best results were obtained the sulfo-NHS-LC-biotin, Using the lithographically sufficient dose, arrays of spots with diameter of 0.5 to 50 microns were created through covalent binding of sulfo-NHS-LC-biotin. The immobilized biotin was detected under a fluorescence microscope after reaction with AlexaFluor® 546 labeled streptavidin. As it shown in Fig. 6, spots with good morphology and intra-spot homogeneity were obtained for the whole range of spot diameters tested. The binding of biotin onto the microstructures created following the proposed method can be applied for the immobilization of any biotinylated protein onto the microstructures by exploiting the biotin streptavidin linkage. To confirm the chemical activity of the epoxy film, the fluorescence substance fluorescein was also immobilized onto an epoxy patterned surface using the reactive fluorescein isothiocyanate ester (FITC). As it is shown in Fig. 13, FITC was also immobilized very effectively onto the photolithographically defined epoxy micro structures. Conclusively any substance that can react with the epoxy resist can be patterned onto the surface and thus, the proposed method can be applied for a wide range of applications beyond patterning of biomolecules. It must be noted that the size of the structures that can be created is limited only by the capacity of the exposure tool whereas at the same time photolithography offers unlimited freedom concerning the structure shape.

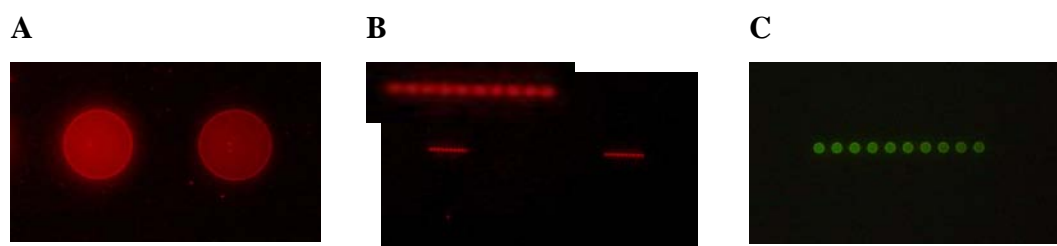


Fig. 13 . Fluorescence images of (a) 50 μm biotin spots, (b) 0.5 μm biotin spots and (c) 5 μm FITC spots created to an epoxy patterned surface. The insert in (b) is a blow-up showing details of the spots.

New photoacid generation approach based on Dawson polyoxometallates

The capability of ammonium 18-molybdodiphosphate, $(\text{NH}_4)_6\text{P}_2\text{Mo}_{18}\text{O}_{62}$, and ammonium 18-tungstodiphosphate, $(\text{NH}_4)_6\text{P}_2\text{W}_{18}\text{O}_{62}$, to generate acid photochemically within polymeric films with hydroxylic functional groups was demonstrated by our group. The polymer mainly investigated was the poly(2-hydroxyethyl methacrylate) (PHEMA). Upon UV irradiation both 2:18 polyoxometalates (POMs) investigated are reduced with concomitant oxidation of PHEMA and generation of acid, which subsequently catalyzes the crosslinking of PHEMA. The photoacid generation was monitored with an appropriate acid indicator (4-dimethylamino-4'-nitrostilbene, DANS) using UV spectroscopy. By comparing the efficiency of both POMs to induce acid-catalyzed crosslinking of PHEMA under similar conditions, the W based ion is found to be more efficient in photoacid generation than the Mo based ion. Imaging of the POM-containing PHEMA films through UV photolithographic processing was demonstrated. It should be emphasized that both POMs can be entirely leached during the development step by using pure water as developer, resulting to patterned PHEMA films (fig.14). This characteristic renders the investigated POMs attractive materials for applications especially in the area of biomaterials where removal of the photoacid generator from the film at the end of the process is desirable.

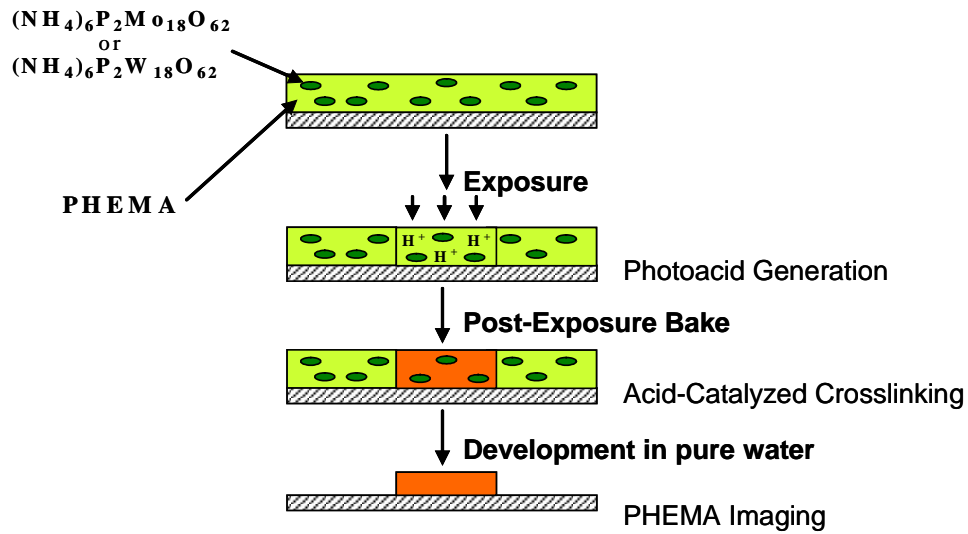


Fig. 14. Lithographic process based on photoacid generation by ammonium salts of Dawson polyoxometallates resulting to PHEMA imaging

Fabrication of [Co/Bi]_n wire structures

[Co(1 nm)/Bi(2.5 nm)]_n ($n = 10$ or 20) line structures on the Si(0 0 1)/SiN_x substrate were fabricated by conventional patterning and deposition steps for the evaluation of the grain-boundary resistance's contribution to the magneto-transport properties. The fabrication involves 2 lithographic and 2 sputtering deposition steps, leading to 5 rectangular-shaped and parallel magnetic lines with thickness 60 nm and line width 2 μm. A rectangular magnetic pad is attached to each line. First, the layout for the magnetic wires is transferred on a photoresist film spin coated on a Si(100)/SiN_x (100 nm) substrate. Then, the substrate is covered with a 60 nm thick magnetic film via sputtering and a lift-off process of the photoresist follows. The wafer with the magnetic wires is covered again with the photoresist and after a second lithography step, the layout of the electrodes appears. Finally, sputter deposition of a thin Cr (20nm) buffer layer and 350nm thick Au layer is followed by a lift-off process of the photoresist, resulting in well defined line structures with pad

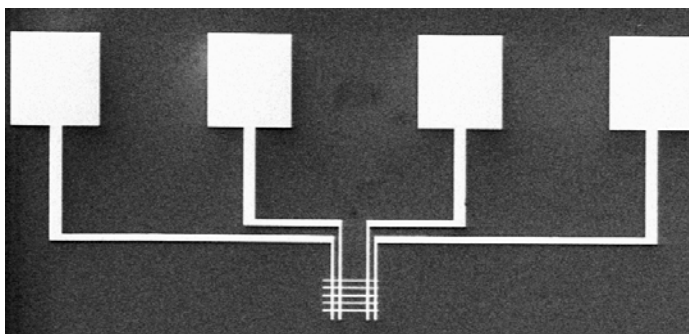


Fig.15. SEM image of the fabricated device. Five [Co/Bi]_n-lines are crossed by four Au electrodes.

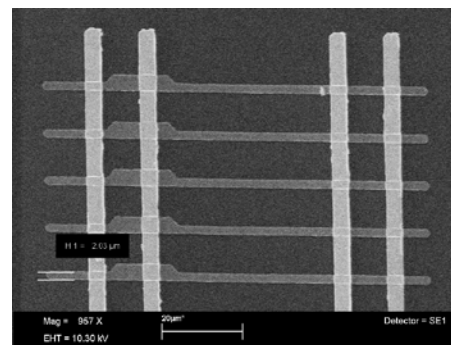


Fig 16. Higher magnification of the structures, showing details of Au-electrodes crossing one magnetic pad and one magnetic line .

c. Materials for organic/molecular electronics

Polyoxometallates as potential molecular components of electronic devices

Polyoxometallates of Mo and W are investigated as potential molecular components of electronic devices and in particular memory devices based either on electron or on proton transport and storage. The relevant activities are carried out in collaboration with Project II.3 (Project Leader N. Glezos) and Project II.2 (Project Leader P. Normand) and the results are reported in the corresponding sections.

Hybrid polymer-inorganic light-emitting diodes with solution-processed polyoxometallates as electron transport layers

Improved performance single-layer polymer light-emitting diodes (PLEDs) based on polyfluorene derivatives were demonstrated. A thin solution processed hydrophilic tungstate polyoxometallates layer, such as $H_3PW_{12}O_{40}$, was introduced between the green emitting copolymer poly[(9,9-dioctylfluorenyl-2,7-diyl)-co-(1,4-benzo-{2,1',3}-thiadiazole)] (YE) and the cathode (Fig. 17) and its role was examined in the improvement of the device performance. Improved efficiencies by a factor of up to 1.5 (Fig. 17) were achieved as a result of the improved electron injection and transport at the cathode/POM interface in PLEDs. Possible mechanisms for improved device performance in the context of energetic level alignment at the cathode/POM interface (Fig. 18) are investigated

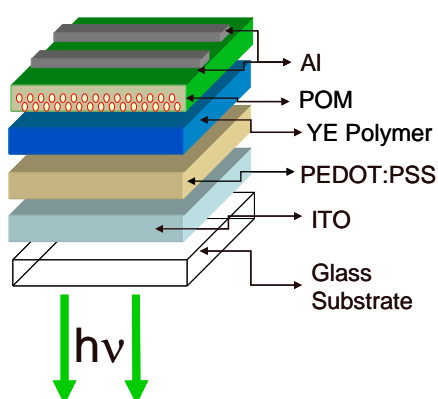


Fig. 17. Device structure (left) and J-V-L characteristics (right) of a YE PLED having a thin POM layer inserted between the cathode and the active layer.

Fig 18. Energy level diagram of a YE/POM LED

Hybrid polymer-inorganic solar cells with solution-processed polyoxometalates as exciton blocking/optical spacer

Improved performance bulk-heterojunction photovoltaics (PVs) based on donor/acceptor polymer (regioregular poly(hexyl-thiophene)/fullerene ([6,6]-phenylC₇₀-butyric acid methyl ester) heterostructures upon inserting a thin layer of POM (Fig. 19) was demonstrated. It should be noticed that POMs represent a family of inorganic molecular oxides well known for their comparable with TiO₂ properties in the area of photocatalysis. In the case of PVs the improved performance upon the insertion of POM (Fig 19.) is attributed to the enhanced absorption as well as the exciton blocking ability of POM in PVs (Fig. 20).

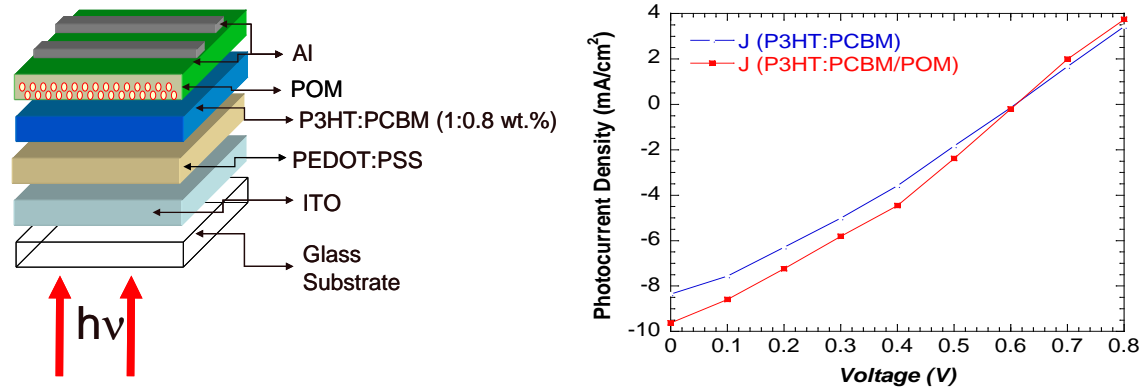


Fig 19. PV device structure with POM layer(left) and J-V characteristics (right) where increased photocurrent suggests improved absorption in the P3HT:PCBM bulk.

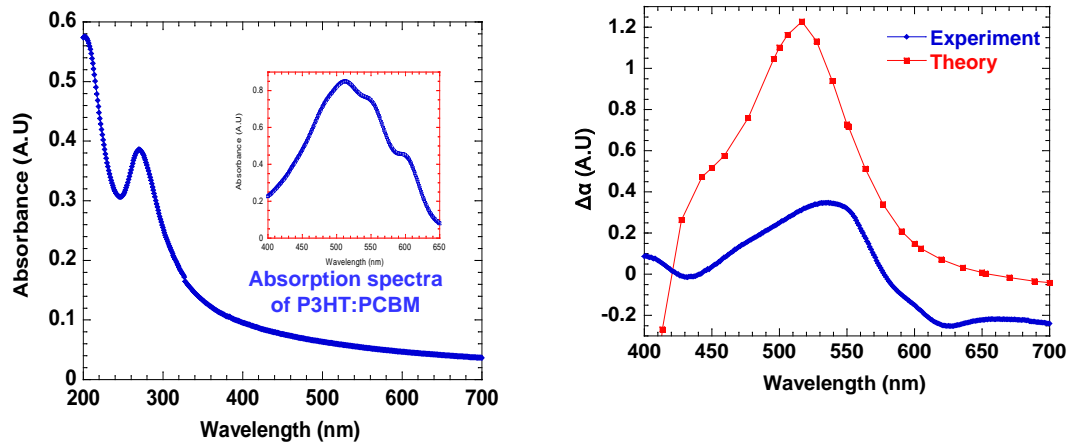


Fig 20. Overall increased absorption in the spectral region where the P3HT:PCBM active layer absorbs when POM is used as an optical spacer.

Tuning the emitting colour of OLEDs: Towards device performance optimization and new applications

Continuing the research activity on the emission tuning of OLEDs following a photochemical route proposed by our group two years ago (M. Vasilopoulou et al., *Adv. Funct. Mater.* 2007), we worked towards the optimization of devices performance and the exploration of new possible applications of this technology in the area of all plastic microsystems.

It was first shown that the addition of photoacid generators (necessary in our emission tuning approach) inside the emissive layer of OLEDs can result to improved charge injection. Fig.21 (left). Although the luminance is in certain cases quenched, (eg when triphenyl sulfonium hexafluoroantimonate is used) the use of selected PAGs, such as the triphenyl sulfonium triflate, results to overall improvement of the device performance as shown in Fig. 21 (right).

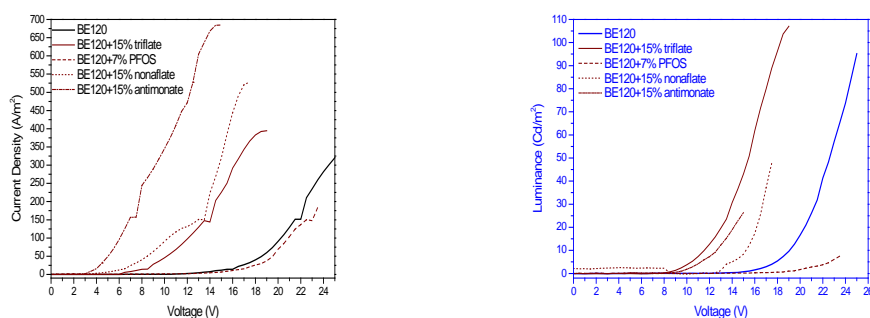


Fig 21. Influence of the addition of photoacid generators in the emissive layer of OLEDs, using as host polymer the Poly[2-(6-cyano-6-methyl-heptyloxy)-1,4-phenylenederivative (commercial name BE 120).

On the other hand blue emitting flexible PLEDs based on either PVK or BE-120 were fabricated and an anti-rabbit IgG antibody, labeled with two different fluorescent dyes (ALEXA or PHYCO) was then adsorbed on the PET substrate. The blue light output of the PLED excited the fluorescent dye resulting in a red shift of the initial spectrum. The size of the shift depends strongly on the concentration of the fluorescent label. The quantum efficiency of the emitting polymers as well as the optimization of the PLED device characteristics play significant role to the sensitivity of this system. The ability to create patterned multi colour PLEDs onto the same substrate, which has been demonstrated by our group two years ago, can improve the selectivity upon different biomolecules present in the same sample by implementing a spectrally different fluorescent label for each biomolecule (Fig 22). The proposed solid-state PLED arrays are simple to construct, have low cost, low power consumption and are entirely flexible.

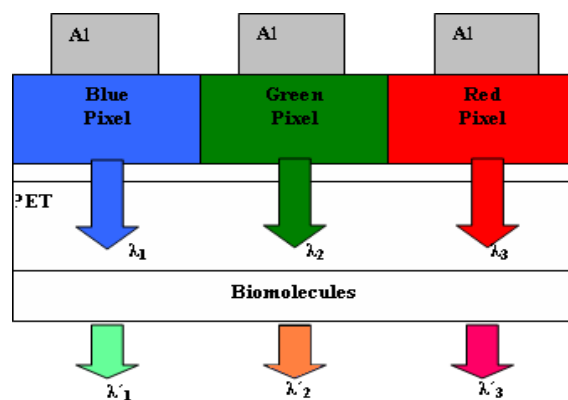


Fig 22. Schematic representation of our approach towards a photopatterned 3-colour PLED device for the simultaneous detection of biomolecules labeled with different fluorescent dyes.

PROJECT OUTPUT IN 2008

Publications in international Journals

1. N. A. Stathopoulos, M. Vasilopoulou, L. C. Palilis, D. G. Georgiadou, and P. Argitis, "A combined experimental and simulation study on thickness dependence of the emission characteristics in multicolor single layer organic light-emitting diodes", **Appl. Phys. Lett.** **93**, 083310, 2008
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3. Eleftherios Kapetanakis, Antonios M. Douvas, Dimitris Velessiotis, Eleni Makarona, Panagiotis Argitis, Nikos Glezos, and Pascal Normand, "Molecular storage elements for proton memory devices", **Advanced Materials** **20 (23)**, 2008, pp. 4568-4574.
4. E. Makarona, E. Kapetanakis, D.M. Velessiotis, A. Douvas, P. Argitis, P. Normand, T. Gotszalk, M. Woszczyna, N. Glezos, "Vertical devices of self-assembled hybrid organic/inorganic monolayers based on tungsten polyoxometalates", **Microelectronic Engineering** **85 (5-6)**, pp. 1399-1402, 2008
5. A.Kokkinis, E.S.Valamontes, D.Goustouridis, Th.Ganetsos, K.Beltsios, I.Raptis "Molecular weight and processing effects on the dissolution properties of thin poly(methyl methacrylate) films", **Microelectron. Eng.** **85**, 93, 2008
6. D.Drygiannakis, G.P.Patsis, K.vanWerden, A.Boudouvis, I.Raptis "Processing effects on the dissolution properties of thin chemically amplified photoresist films", **Microelectron. Eng.** **85**, 955, 2008
7. M.Chatzychristidi, E.Valamontes, N.Tsikrikas, P.Argitis, I.Raptis, J.A.van Kan, F.Zhang, F.Watt, "High-aspect-ratio micro/nano machining with proton beam writing on aqueous developable - easily stripped negative chemically amplified resists", **Microelectron. Eng.** **85**, 945, 2008
8. C.Christides, Th.Speliotis, M.Chatzychristidi, I.Raptis "Large asymmetries of magnetoresistance loops in Co-line structures", **Microelectron. Eng.** **85**, 1382, 2008
9. D.Drygiannakis, G.P.Patsis, N.Tsikrikas, G.Kokkoris, I.Raptis, A.Boudouvis, E.Gogolides, P.Argitis "Stochastic simulation studies of molecular resists for the 32nm technology node", **Microelectron. Eng.** **85**, 949, 2008
10. M.Chatzychristidi, I.Rajta Th.Speliotis, E.Valamontes, D.Goustouridis, P.Argitis, I.Raptis "Aqueous base developable - easy stripping, high aspect ratio negative photoresist for optical and proton beam lithography", **Microsyst. Technol.**, **14**, 1423, 2008
11. N.Tsikrikas, G.P.Patsis, I.Raptis, A.Gerardino, E.Quesnel "Electron beam lithography simulation for the patterning of EUV masks", **Jpn. J. Appl. Phys.** **47** 4909, 2008
12. C.Christides, Th.Speliotis, M.Chatzychristidi, I.Raptis "Magneto-transport properties of [Co/Bi]_n wire structures", **J. Magn. Magn. Mater.**, **320**, e720, 2008
13. E.Valamontes, M.Chatzychristidi, N.Tsikrikas, D.Goustouridis, I.Raptis, C. Potiriadis, J.A.vanKan, F.Watt "Realization and simulation of high aspect ratio micro/nano structures by proton beam writing", **Jpn. J. Appl. Phys.** **47**, 8600, 2008
14. D. Georgiadou, M. Vasilopoulou, G. Pistolis, D. Dimotikali and P. Argitis, "Energy transfer processes among emitters dispersed in a single polymer layer for colour tuning in OLEDs", **Physica Status Solidi (A) Applications and Materials**, **205 (11)**, pp. 2526-2531, 2008
15. N. Stathopoulos, L. C. Palilis, M. Vasilopoulou, A. Botsialas, P. Falaras, and P. Argitis, "All-organic optocouplers based on polymer light-emitting diodes and photodetectors", **Physica Status Solidi (A) Applications and Materials**, **205 (11)**, pp. 2522-2525, 2008
16. E. Sarantopoulou, Z. Kollia, M. Chatzychristidi, A. Douvas, P. Argitis, S. Kobe, A. C. Cefalas, "Dynamics and laser processing of functional fluoride organic surfaces at VUV wavelengths", **Journal of Laser Micro/Nanoengineering** **3**, 24-29, 2008

Publications in international Conference Proceedings

1. M. Vasilopoulou, P. Argitis, G. Aspiotis, G. Papadimitropoulos and D. Davazoglou «Flexible WO₃ based electrochromic displays using proton conducting solid electrolytes», *Physica Status Solidi (C) Current Topics in Solid State Physics* 5 (12), 2008, pp. 3868-3871.
2. M. Vasilopoulou, L. C. Palilis, A. Botsialas, D. Georgiadou, , P. Bayiati, N. Vourdas, P. S. Petrou, G. Pistolis, N. Stathopoulos, and P. Argitis, «Flexible Organic Light Emitting Diodes (OLEDs) based on blue emitting polymers», *Physica Status Solidi (C) Current Topics in Solid State Physics* 5 (12), 2008, pp. 3658-3662.

Presentations in international Conferences

1. L.C. Palilis, M.Vasilopoulou, K.Kotsovos, A.Botsialas, E.Ntantoumis, P.Argitis, "Hybrid polymer-inorganic solar cells and light-emitting diodes with solution-processed polyoxometalates as exciton blocking/optical spacer and electron transport layers", European Materials Research Society (E-MRS) Conference 2008, Strasburg, France, 2008.
2. P.Dimitrakis, L.C.Palilis, M.Vasilopoulou, G.Papadimitropoulos, D.Davazoglou, P.Argitis, P.Normand, "Self-organization of Cu nanoparticles on polythiophene layers for bistable memory devices" European Materials Research Society (E-MRS) Conference 2008, Strasburg, France, 2008.
3. L.C.Palilis, M.Vasilopoulou, K.Kotsovos, D.G.Georgiadou, A.Botsialas, E.Ntantoumis, P.Argitis, "Hybrid polymer-inorganic solar cells and light-emitting diodes with polyoxometalates as dual-function optical spacer and electron injection layers", 1st International Symposium on Flexible Organic Electronics (IS-FOE), Halkidiki, Greece, 2008.
4. L.C.Palilis, M.Vasilopoulou, N.A.Stathopoulos, A.Botsialas, D.G.Georgiadou, G.Pistolis, D.Davazoglou, P.Falaras, P.Argitis, "Air-stable solution-processed polymer optocouplers", 1st International Symposium on Flexible Organic Electronics (IS-FOE), Halkidiki, Greece, 2008
5. M.Vasilopoulou, D.G.Georgiadou, L.C.Palilis, G.Pistolis, P.Argitis, "Photochemical study of organic dyes for color tuning in dye-doped OLEDs", 1st International Symposium on Flexible Organic Electronics (IS-FOE), Halkidiki, Greece, 2008.
6. N.A. Stathopoulos, M.Vasilopoulou, L.C.Palilis, D.G.Georgiadou, P.Argitis, "Thickness effects on the emitting properties of single layer polymer light-emitting diodes (PLEDs) – A combined experimental and theoretical study", 1st International Symposium on Flexible Organic Electronics (IS-FOE), Halkidiki, Greece, 2008.
7. D.G. Georgiadou, M.Vasilopoulou, L.C.Palilis, G.Pistolis, P.Argitis, "Improved charge injection in OLEDs via onium-salt addition inside polymer matrices", 1st International Symposium on Flexible Organic Electronics (IS-FOE), Halkidiki, Greece, 2008. Young Researcher's Award for the Best Poster Presentation.
8. D.G. Georgiadou, M. Vasilopoulou, L. Palilis, G.Pistolis, P.Argitis, "Photochemically Induced Emission tuning of fluorescent and phosphorescent emitters in full colour, single layer organic light emitting diodes", IV International Krutyn summer School, Masurian Lake District, Poland, 2008.
9. P. Pavli, P.S. Petrou, M. Chatzichristidi, A.M. Douvas, D. Niakoula, S.E. Kakabakos, D. Dimotikali, P. Argitis, "Photoresist-based lithographic process for biomolecules patterning through chemical binding on the substrate", 3rd International Workshop on Multianalyte Biosensing Devices 18-19/09/2008.
10. P. Pavli, P. S. Petrou, D. Niakoula, A. M. Douvas, M. Chatzichristidi, S. E. Kakabakos, D. Dimotikali, P. Argitis, "Chemical binding of biomolecules to micropatterned epoxy modified surfaces for biosensing applications", International conference on Micro- and Nano- Engineering (MNE), September 18-21 2008, Athens Greece.
11. M. Vasilopoulou, P. S. Petrou, S. E. Kakabakos, L. C. Palilis , D. Georgiadou, A. Botsialas , P. Argitis, "Photopatterned Polymer Light-Emitting Diode (PLED) arrays for

- biosensing applications”, International conference on Micro- and Nano- Engineering (MNE), September 18-21 2008, Athens Greece.
12. M. Vasilopoulou, A. M. Douvas , L. C. Palilis, P. Bayiati, D. Alexandropoulos, N. A. Stathopoulos and P. Argitis, “Partially Fluorinated Methacrylate Polymers as Active and Cladding Components in Optical Waveguides”, International conference on Micro- and Nano- Engineering (MNE), September 18-21 2008, Athens Greece.
 13. T. Manouras, A.M Douvas, M.Chatzychristidi, N.Vourdas, E.Gogolides, P.Argitis. A new imaging approach based on a thermally developable, etch resistant molecular material. International conference on Micro- and Nano- Engineering (MNE), September 18-21 2008,
 14. E. Kapetanakis, A. M. Douvas, D. Velessiotis, E. Makarona, P. Argitis, N. Glezos, P. Normand, “Molecular proton memory”, 34th International Conference on Micro- and Nano-Engineering (MNE), Athens, Greece, September 15-19, 2008.

Awards

Young Researcher's Award for the Best Poster Presentation to the graduate student **Dimitra G. Georgiadou** in the **1st International Symposium on Flexible Organic Electronics (IS-FOE), Halkidiki, Greece, July 2008**, for the paper :

D.G.Georgiadou, M.Vasilopoulou, L.C.Palilis, G.Pistolis, P.Argitis, “Improved charge injection in OLEDs via onium-salt addition inside polymer matrices”

Patent Applications

“Memory devices using proton-conducting polymeric materials”, E. Kapetanakis, A. M. Douvas, D. Velessiotis, E. Makarona, P. Argitis, N. Glezos, P. Normand, Greek Patent Application No 20080100269, 18-04-2008.