Project III. 2: BIO-MICROSYSTEMS

Project leader: K. Misiakos

Other key researchers (from the Institute): P. Argitis, E. Gogolides, A. Tserepi, G. Raptis and H. Contopanagos

PhD candidates: M. Vlachopoulou

Projects Running:

- IST-2000-28214, BIOMIC

Goals

- Integrated Optical Bioanalytical Devices

Main results (2004): SNP detection in DNA arrays, cardiac marker detection and label-free protein detection

The monolithic optoelectronic bio-transducer developed at IMEL was optimized and coupled to a fluidic module (see *fig. III.1.1*).

Fig. III.2.1 shows a schematic of the transducer and the aligned fluidic cover. A packaged device is shown in fig. III.2.3, while figs. III.2.4, and III.2.5 show characterization results.

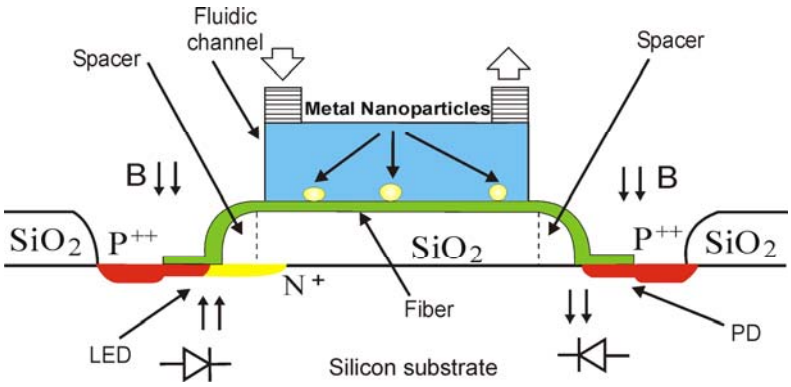

Fig. III.2.1: *Schematic illustration showing the monolithic optoelectronic bio-transducer coupled to a fluidic module. This fluidic module is shown below and covers in series all nine fibers per chip.*

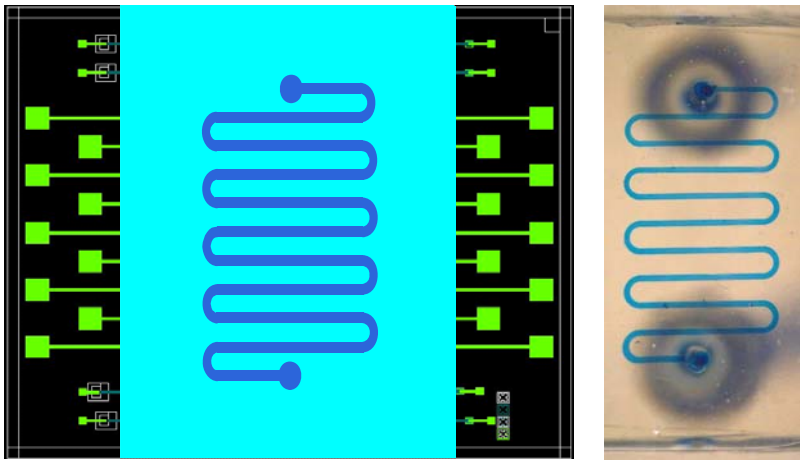

Fig. III.2.2: *Schematic (top view) of the transducer and the aligned fluidic cover (left). On the right, a photo the fluidic cover is shown with a blue dye liquid inside the channel.*

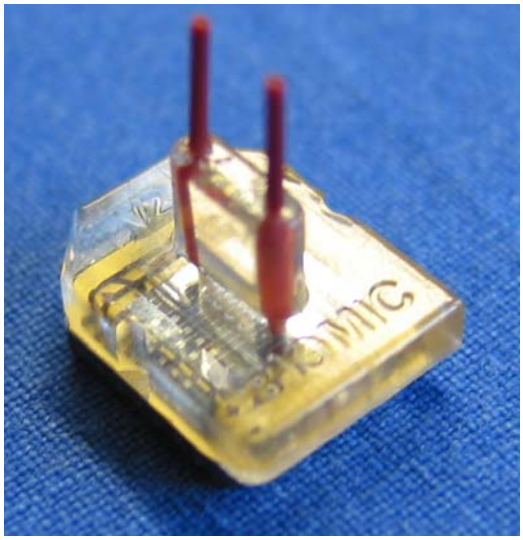

Fig. III.2.3: *Packaged device, with all electronic and fluidic connection in place, for use in the field in a portable instrument.*

The analytical capabilities of the device were demonstrated by performing a non-competitive immunoassay for the MB isoform of the creatinine kinase enzyme (CK-MB). CK-MB is one of the most widely used markers for the early diagnosis of cardiac infarction. Also it was demonstrated by the detection of DNA single nucleotide polymorphism

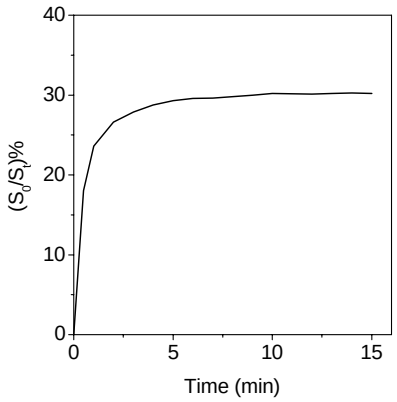

Fig.III.2.4: *Real-time response plotted as the ratio of the initial detector photocurrent (S_0) to the instantaneous photocurrent (S_t). The CK-MB concentration 300 ng/mL.*

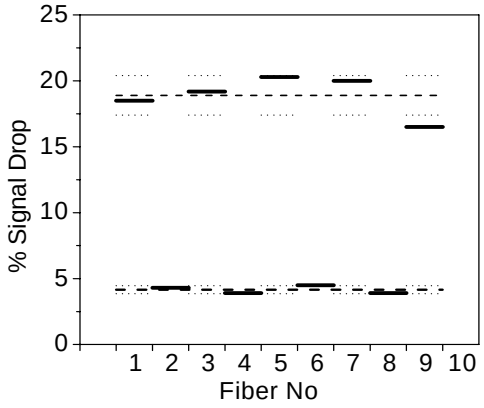

Fig. III.2.5: *Signal obtained from the 9 fibers of a single chip after hybridization. Odd fibers were modified with full-matching sequences and even fibers with single base mismatching sequences*

PUBLICATIONS in INTERNATIONAL JOURNALS

1. "Protein patterning by micromachined silicon embossing on polymer surfaces", Goustouridis D, Misiakos K, Petrou P S, Kakabakos S E, *Applied Physics Letters 85* (26): 6418-6420 (2004)
2. "Selective plasma-induced deposition of fluorocarbon films on metal surfaces for actuation in microfluidics", Bayiati P, Tserepi A, Gogolides E, Misiakos K, *Journal of Vacuum Science & Technology A* 22 (4): 1546-1551 (2004)
3. "A monolithic silicon optoelectronic transducer as a real-time affinity biosensor", Misiakos K, Kakabakos S E, Petrou P S, Ruf H H, *Analytical Chemistry* 76 (5): 1366-1373 (2004)

PUBLICATIONS in CONFERENCE PROCEEDINGS

1. "Laser ablation of polymeric layers for fabrication of biomolecule microarrays" P. S. Petrou, A. Douvas, S. E. Kakabakos, K. Misiakos, P. Argitis, E. Sarantopoulou, Z. Kollia and C. Cefalas, *2nd International Workshop on Multi-analyte Biosensing Devices*, Tarragona, Spain, 18-20 February, 2004, Abstract p. 33
2. "Sub-10 μm protein microarrays fabricated using new near UV photoresist and novel multi-step lithographic scheme", M. Chatzichristidi, A. Douvas, K. Misiakos, I. Raptis, C. D. Diakoumakos, P. Petrou, S. E. Kakabakos and P. Argitis, *2nd International Workshop on Multi-analyte Biosensing Devices,* Tarragona, Spain, 18-20 February, 2004, Abstract p. 32

3. "Printing protein patterns". K. Misiakos, D. Goustouridis, S. Kakabakos, P. Petrou. 2nd International Workshop on Multi-analyte Biosensing Devices, Tarragona, Spain, 18-20 February, 2004, Abstract p. 38
4. "Multianalyte integrated optical biosensors based on monolithic silicon optoelectronic transducers" K. Misiakos, S. Kakabakos, P. Petrou and H. Ruf, *2nd International Workshop on Multi-analyte Biosensing Devices*, Tarragona, Spain, 18-20 February, 2004, Abstract p. 60
5. "Development of a capillary-based fluoroimmunosensor capable for real-time measurement of the analytical signal", C. Mastichiadis, S. E. Kakabakos, P. S. Petrou, I. Christofidis and K. Misiakos, *2nd International Workshop on Multi-analyte Biosensing Devices*, Tarragona, Spain, 18-20 February, 2004, Abstract p. 70
6. "Fabrication of microscale protein arrays for low crosstalk electrochemical sensing", A. Bush, I. Katakis, M. Chatzichristidi, K. Misiakos and P. Argitis, *2nd International Workshop on Multi-analyte Biosensing Devices*, Tarragona, Spain, 18-20 February, 2004**,** Abstract p. 36
7. "Plasma-deposited fluorocarbon films for use in actuation of fluid movement in microfluidic devices", Bayiati P., Tserepi A, Gogolides E, Misiakos K**,** Abstract p. 67

PRESENTATION in CONFERENCES

1. "A bioanalytical microsystem for protein and DNA sensing based on a monolithic silicon optoelectronic transducer", K. Misiakos, P.S. Petrou, S.E. Kakabakos, H. H. Ruf, T. Knoll, E. Ehrentreich-Foerster and F.F. Bier, *Second Conference on Microelectronics Microsystems and Nanotechnology,* Athens, Greece, 15-17 November, 2004
2. "New lithographic process and resist capable for fabrication of submicron protein microarrays", Chatzichristidi M., Douvas A., Misiakos K., Raptis I., Diakoumakos C. D., Argitis P., Petrou P. S. and. Kakabakos S.E, *Second Conference on Microelectronics Microsystems and Nanotechnology*, Athens, Greece, 15-17 November, 2004

PATENT APPLICATIONS IN 2004

1. "Integrated optoelectronic silicon biosensor for the detection of biomolecules labeled with chromophore groups or nanoparticles", K. Misiakos and S. Kakabakos, **European patent EP 1448978**
2. "Photoresists processable under biocompatible conditions for multi-biomolecule patterning", P. Argitis, K. Misiakos, S. Kakabakos, A, Douvas and C. Diakoumakos, **European patent EP 1395878**

CONFERENCE ORGANIZATION

2nd International Workshop on Multi-analyte Biosensing Devices, Tarragona, Spain, 18-20 February, 2004