LABEL-FREE SENSORS

LF-1 **Employing dual polarisation biosensing to study the conformational behaviour of BSA molecules during the adsorption to a silicon microring**
J.-W. Hoste[a,b], S. Werquin[a,b], P. Bienstman[a,b]
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LF-3 **Magnetoelastic biosensors combined with a surface-scanning coil detector for real-time detection of pathogen contamination on fresh produce**
Y. Chai, S. Horikawa, H. C. Wikle, B. A. Chin
Materials Research and Education Center, Auburn University, Auburn, AL, USA

LF-5 **Handheld biosensor for high-throughput and multiplexed sensing in resource-poor settings**
A. E. Cetin[a,b], H. Altug[a,b]
[a]*Department of Electrical and Computer Engineering, Boston University, USA*
[b]*Bioengineering Department, EPFL, Lausanne, Switzerland*

LF-7 **Ultra-sensitive MTJ based magnetic field sensor**
M. Kavaldzhiev[a], Ph. Sabon[a], N. Dempsey[b], D. Le Roy[b], C. Cavoit[c], C. Baraduc[a], I. L. Prejbeanu[a], B. Diény[a]
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LF-9 **Sensitivity enhancement of LSPR fiber-optic sensor based on gold nanoparticles enveloped in silicon nitride film and its bio-application**
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[b]*Department of Electrical Engineering*
[c]*WRCBB, Department of Bioscience and Bioengineering*
[d]*Centre of Excellence in Nanoelectronics, Indian Institute of Technology Bombay, Mumbai, India*

LF-11 **Label-free detection of lysozyme in wines using an aptamer-based biosensor and SPR detection**
I. Mihai, A. Vezeanu, V. Andrei, A. Vasilescu
International Centre of Biodynamics, Bucharest, Romania

LF-13 **A label-free biosensor based on Bloch Surface Wave sustained by functionalized photonic crystal**
V. Moi[a], F. Frascella[a], S. Ricciardi[a], P. Rivolo[a], E. Descrovi[a], L. Napione[b], F. Bussolino[b], F. Giorgis[a]
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[b]*Dipartimento di Scienze Oncologiche, Institute for Cancer Research and Treatment, Università di Torino, Candiolo, Italy*

LF-15 **Location-specific sensing by masked plasmonic nanoparticles**
V. Häfele[a], S. Köstler[b], P. Abuja[c], J. Krenn[a], A. Leitner[a]
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[c]*Institute of Pathology, Medical University of Graz, Graz, Austria*

LAB-ON-CHIP

LOC-1 **On-chip mid-infrared GaAs/AlGaAs Mach-Zehnder Interferometer**
M. Sieger[a], X. Wang[a], L. Leidner[b], M. Ewald[b], G. Gauglitz[a,b], B. Mizaikoff[a]
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LOC-3 **MRR-based photonic biosensing circuits of high-complexity and compactness based on combination of monolithic and hybrid integration**
P. Groumas[a], L. Gounaridis[a], R. Heideman[b], E. Schreuder[b], Ch. Kouloumentas[a], H. Avramopoulos[a]
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LOC-5 **Flat fiber as a novel photonic integration platform for optofluidic based biosensing devices and lab on chip applications: Future perspectives**
C. Riziotis[a], K. Kalli[b], A. Posporis[b], C. Koutsides[b], A. El Sachat[a], A. S. Webb[c], C. Holmes[c], J. C. Gates[c], J. K. Sahu[c], P. G. R. Smith[c]
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[c]*Optoelectronics Research Centre, University of Southampton, Southampton, UK*

LOC-7 **Biofunctionalized nanoslits for fluorescence monitoring of protein binding kinetics**
P. Teerapanich[a], M. Pugniere[b], Y. L. Lin[c], C. F. Chou[c], T. Leïchle[a]
[a]*LAAS-CNRS, Université de Toulouse, Toulouse, France*
[b]*Institut de Recherché en Cancerologie de Montpellier, Montpellier, France*
[c]*Institute of Physics, Academia Sinica, Taipei, Taiwan*

LOC-9 **Microwell arrays: studying the metabolic responses of single mitochondria**
V. S. Vajrala[a], S. Emmanuel[a], G. Bertrand[a], A. Devin[b], M. Rigoulet[b], S. Arbault[a], N. Sojic[a]
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[b]*Institut de Biochimie et Génétique Cellulaires, Université Bordeaux 2, France*

LOC-11 **The refinement in the novel microchip design for the determination of catecholamines in micro total analysis system (μ-TAS)**
C. Cakal[a], J. P. Landers[b], J. P. Ferrance[b], P. Caglar[a]
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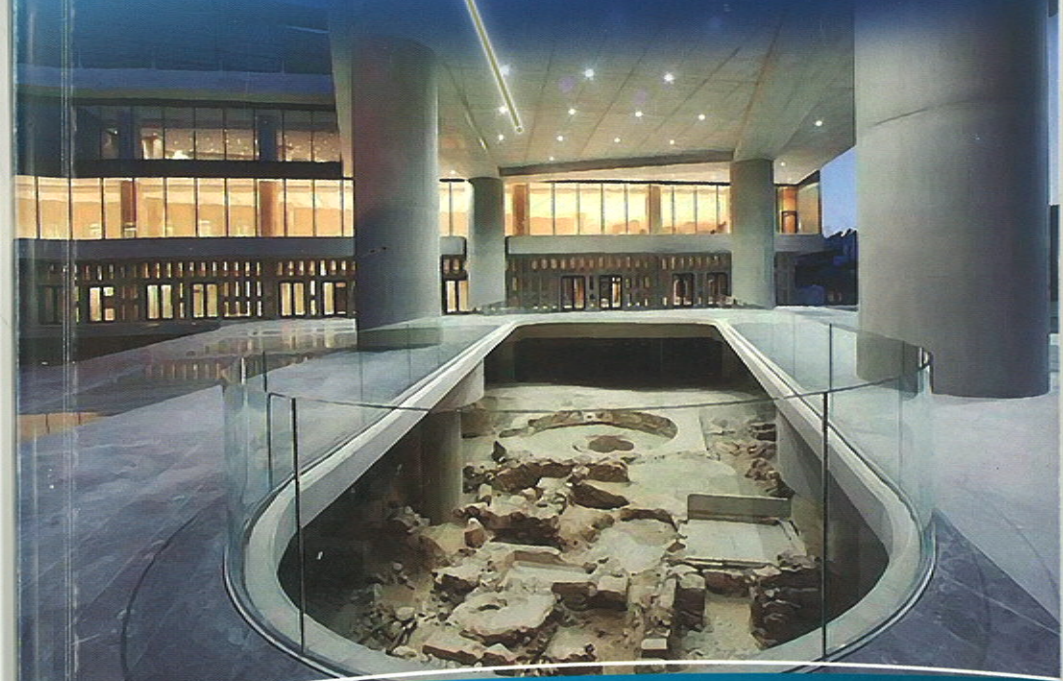

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Employing dual polarisation biosensing to study the conformational behaviour of BSA molecules during the adsorption to a silicon microring

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The stark decrease in efficiency in producing new pharmaceuticals has urged the Food and Drug Administration (FDA) to launch the FDA Critical Path Initiative in 2004, a guideline to address the increasing difficulty of medical product development. An important point of criticism is the lack of high-throughput tools to study molecular behavior of the drug candidates we produce. This could elucidate potential drugs which are filtered out by current affinity based tools. To accommodate this, we propose a biosensor that can detect conformational changes of proteins, based on an integrated Silicon-on-Insulator (SOI) microring. Previous microring biosensors excite the cavity with a single polarization, thus only gaining information on the total bound mass of proteins. We succeeded in exciting the microring with two polarizations simultaneously and as such could extract information about the thickness and the refractive index of the bound layer of molecules. This enables the biosensor to distinguish between a thin dense layer and a thick sparse layer, which is not possible by tracking a single resonance.

In order to excite both polarisations we use a microring with an asymmetrical directional coupler. In [1] it is shown that a microring with a TE mode in the access waveguide can successfully excite the TM mode in the ring waveguide if the widths of both waveguides are such that phase matching occurs. We have shown that if the two waveguides are brought sufficiently close together, the TE mode in the access waveguide can also excite a TE mode in the ring waveguide, even though there is a severe phase mismatch. Fig. 1 shows a measurement of the spectrum of a ring that was designed with such a coupling section, exhibiting two distinct sets of resonances with a different free spectral range. When proteins bind or adsorb to the silicon surface, the resonance wavelength of both resonances will shift. These peak positions can be solved to a thickness and refractive index profile using a theoretical model based on waveguide theory and simulated modal parameters.

As a proof-of-concept the adsorption behaviour of bovine serum albumin (BSA) molecules has been examined. The adsorbed mass, thickness and refractive index of a layer of adsorbed BSA molecules have been tracked while cycling the pH of the buffer. This experiment has been done with dual polarization interferometry(DPI), which lacks high-throughput possibilities, on a silicon nitride surface in [2]. This provides a good way to verify our results. Before the actual experiment takes place, water and buffer are flowed over the chip in order to calibrate the sensor. Next, a 0.1 mg/ml BSA in phosphate buffer solution (PBS) is flowed over the sensor with a pH of 5. Then we switch the fluid to BSA in PBS pH 3 before switching it back to BSA in PBS pH 5. The measured shifts of both the TE and the TM modes are shown on Fig.2. The adsorbed mass of the BSA layer as a product of thickness and density is shown in Fig.3, while the resolved thickness and refractive index of the layer is shown in Fig. 4. Table 1 compares the results obtained with the presented technique and the DPI technique. The increased adsorption of the microring, the small variations in thickness and refractive index, as well as the irreversible adsorption on the silicon can be attributed to a more hydrophilic silicon surface as opposed to silicon nitride, as is confirmed in [3].

We can conclude that the dual polarization biosensor was able to detect small changes in thickness and refractive index of an adsorbed layer of BSA molecule, which were in good agreement with literature.

	t pH 3	*n pH 3*	*M pH 3*	*t pH 5*	*n pH 5*	*M pH 5*
Microring	1.4 nm	1.433	1.7 ng/mm^2	3.0 nm	1.407	2.70 ng/mm^2
DPI	0.8 nm	1.445	0.48 ng/mm^2	4.8 nm	1.425	2.11 ng/mm^2

Table 1. Comparison of thickness (t), refractive index(n) and adsorbed mass (M) of the BSA experiment as measured by the technique presented in this paper (Microring) and the DPI technique [2].

[1] P. De Heyn, D. Vermeulen, et al. IEEE Phot. Tech. Letters, 24 14, 1176-1178(2012)
[2] N.J. Freeman, L.L. Peel, et al. J. Phys.: Condensed matter, 16, 2493-2496(2004)
[3] Y.L. Jeyachandran, E. Mielczarski, et al. Langmuir: surfaces and colloids, 25 19, 11614-11620(2009)

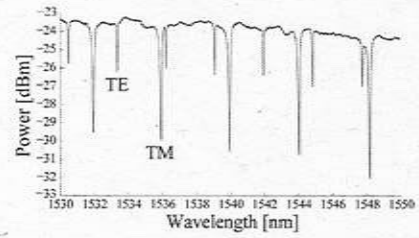

Figure 1. Spectrum of the microring with water cladding.

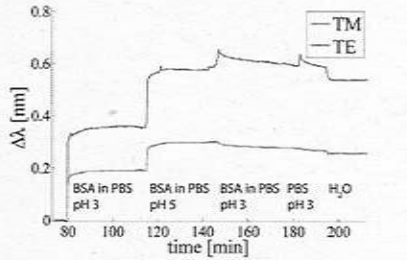

Figure 2. Resonance wavelength shift of both modes during BSA adsorption experiment

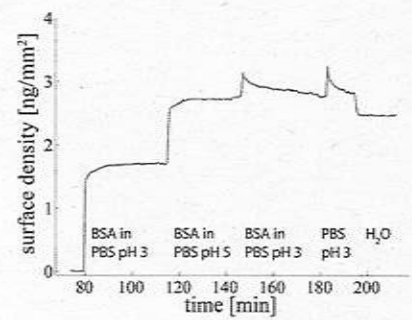

Figure 3. Adsorbed mass of BSA molecules.

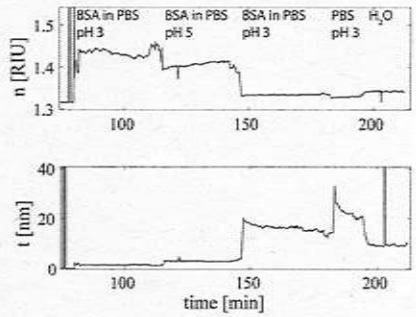

Figure 4. Resolved refractive index and thickness of adsorbed layer of BSA molecules.