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Optical and electrical Si-based biosensors: Fabrication and transduction issues

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Abstract

The interest in miniaturized biosensors is strongly driving the research efforts in finding both new devices and innovative solutions aimed to immobilize the organic layer to the inorganic device active surface. In this work we discussed feasibility studies and examples of biological molecules integration in Si-based miniaturized devices. We investigated three main issues: (i) device surface functionalization, (ii) biological molecule functionality after immobilization and (iii) biosensor working principle using both electrical and optical transduction mechanisms. In the first case the idea is to fabricate electrolyte-insulator-semiconductor (EIS) and, in the near future, ion-sensitive field effect transistor (ISFET) biosensors. The electrical characterization of MOS-like capacitors with ssDNA anchored on the SiO_2 dielectric, allowed us to conclude that the structures tested are sensitive to DNA immobilization and hybridization, as demonstrated by a positive shift in the V_{FB} of +0.47 ± 0.04 V after ssDNA immobilization and by a further +0.07 ± 0.02 V shift when hybridization occurs. The optical transduction mechanism, closer to commercial devices (e.g. DNA-chip) is based on the use of pixelated solid state photon-detectors (Silicon Photomultipliers, SiPM), produced by STMicroelectronics in Catania. They can compete with traditional photomultipliers tubes in those applications where ultra-low light detection is required wishing low power consumption, magnetic shielding and low volume occupancy. The first data of SiPM used as biosensors will be discussed.

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Biography

Sebania Libertino got her Ph.D. in 1998. From 1997 to worked as Researcher at the Microelectronic and Microsystems institute (IMM) of the Italian National Council of Research (CNR), since 2007 as Senior researcher.

Her research interests are oriented to the design and fabrication of Si-based microelectronic and optoelectronic devices and to the study of biological molecules integration in Si-based devices for sensor applications. She has co-authored about 100 papers published in international journals, books, or conference proceedings. She holds 3 European patents, all extended to USA. She was eternal tutor of 12 bachelor and 4 Ph.D. thesis.