Composite Porous Silicon-Crystalline Silicon microcantilevers for biological recognition

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Abstract

Biosensing technology is a rapidly advancing field that benefits from the possibility to use the properties of functional advanced materials to analyse biological systems. In particular, nanomechanical systems are very attractive for biological sensing since mechanical interactions are fundamental to biology. Indeed, nanomechanical devices allow measuring forces, displacements and mass changes from cellular processes, and provide high sensitivity and fast responses, which is necessary for the observation of biological processes [1]. On the other hand, among all the functional materials, PSi constitutes an ideal substrate for developing new chemistries owing to its biocompatibility, well-established fabrication methods and large adsorption surface area, which allows an enhanced sensitivity [2]. In this work, we will start by reviewing the processes for the PSi formation on microcantilevers and their biofunctionalization in order to trigger its sensitivity as biosensing platform. Secondly, we will describe current approaches based upon modification by self-assembled silane monolayers, which critically depend on the type of process for the activation of PSi. Depending on the molecular structure of the monolayers, the surface presents hydrophobic/hydrophilic properties, allows a molecular selectivity, and a local control of the biomolecular interactions. Dynamic experiments involving condensation and evaporation of water on the functionalized PSi samples will be carried out by wetSTEM in order to study and characterize their interaction with water. The surface of the functionalized material will then be biologically activated for the detection of specific genomic or proteomic species applying surface immobilization techniques. Finally, the process of formation of the biorecognition interface will be applied to composite porous silicon-crystalline silicon cantilevers and preliminary sensing results will be shown. [1] M. Calleja, P.M. Kosaka, A. San Paulo, J. Tamayo, Nanoscale. 4, 4925-4938 (2012)

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