Characterization of nanomechanical biosensors for DNA detection by Scanning Light Analyzer and Fluorescence Microscopy.

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Nanomechanical biosensors are based on the principle that molecular recognition on the surface of a biofunctionalized cantilever, results in its bending by few nanometers (static mode) or in changes in its resonant frequency (dynamic mode). On both modes, the origin of the nanomechanical response is the change of the surface stress due to electrostatic, Van der Waals forces and steric intermolecular interactions on the cantilever's surface. These sensors require covalent chemioadsorption of biomolecules on one side of the cantilever through means of surface chemistry.

Cantilever deflections are monitored as a direct measure of adsorption-induced surface stress. Fast deflection sensing and full 3D characterization of cantilever arrays of any size are possible with a Scanning Light Analyzer (SCALA), a new platform developed by Mecwins [1,2].

We have used SCALA to detect the immobilization of DNA molecules on chemically-modified silicon microcantilever biochips. The biosensing principle, applied as the key application for DNA detection, is based on the role of hydration forces in controlled biolayers [3]. To perform this experiment, the upper surfaces of cantilevers in a silicon chip were chemically-modified to generate a high density of silanol groups. Afterwards, a solution containing fluorecescence marked amine-modified single-stranded (ss) DNA was dropped on one of the modified surface of the cantilever, resulting in the adsorption of amine-modified ssDNA molecules onto the cantilever's surface forming a self-assembled monolayer (SAM). Simultaneously to the characterization done with SCALA, samples were examined by fluorescence microscopy to relate the homogeneity and density of biomolecules with the measured surface stress.

References

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