Protein Detection with Scanning Light Analyzer (SCALA)

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In the last years, microcantilevers have been increasingly used as mechanical transducers of molecular recognition events. The transduction signal of nanomechanical sensors is a nano-scale motion. This nanometric deformation arises from the intermolecular forces produced from molecular recognition interactions on the sensitized surface of a microcantilever. Main techniques for the readout of the nanomechanical response include the optical lever method, interferometry-based methods, integrated optical waveguides and the use of piezoresistive cantilevers. The optical lever method is the most used due to the extreme accuracy and easy implementation for measuring cantilevers.

In this contribution we present an application of the SCAnning Light Analyzer instrument, SCALA,[1],[2] to the detection of proteins. This instrument is based on the scanning of a laser beam across a surface (up to centimeters). The reflected beam during the scanning is collected on a position sensitive detector (PSD). This allows the instruments to perform the read-out of arrays of nanomechanical systems without limitation in the geometry of the sample, with high sensitivity and a spatial resolution of few micrometers. The read-out can be made both in one-point deflection measurement or the whole cantilever profile deflection measurement.

We have used this technology to measure the response of cantilever arrays covered with a layer of goat anti-rabbit IgG to hydration forces. We have followed similar protocol described in [3] to form a layer of proteins on the surface of the cantilever sensor. After that, we have measured the cantilever arrays deflection as we increase the relative humidity in a controlled environmental chamber. In order to perform detection, we have incubated the cantilever arrays in Rabbit IgG solution (100 ugr/mL) for different times. The response of the sensor with anti-rabbit IgG layer shows a peak with increasing relative humidity. The position of this peak is around 10-15 %. This type of response is similar to other published in previous works with different biomolecules immobilised on the surface of the cantilever[4]. This could be explained as the response of a monolayer of standing up proteins. When the sensor is incubated in rabbit IgG solution this peak response is decreased. For an incubation time of 500 minutes the peak response fully disappears and the sensor response is characterized by a monotonous decrease with increasing relative humidity. This response can be explained as the monolayer of anti-IgG being fully bonded to rabbit-IgG so that water molecules can't diffuse into holes as described in [4].

This results show how detection of proteins can be made through measurements of hydration forces on cantilever arrays. As the technology of SCALA is capable of reading-out tens of cantilevers per second, it could be possible to develop a cantilever array chip for medical diagnostics purposes providing test results in few hours.

References

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Figure 1

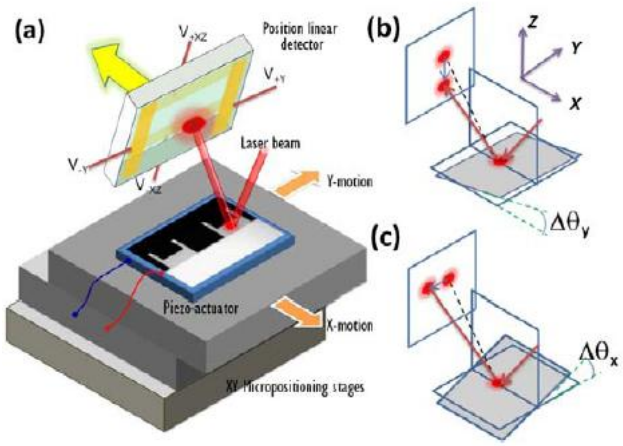

Figure1. Schematic of the SCAnning Laser Analyzer system. (a) Set up, (b) Detection of vertical deflection (c) Detection of lateral deflection.

Figure 2

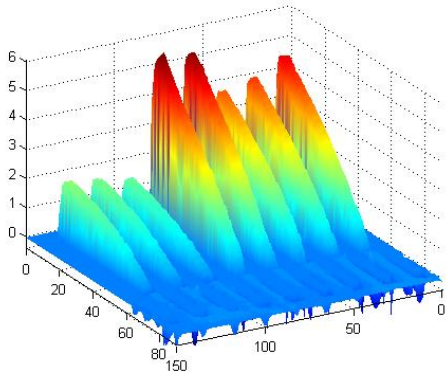

Figure2. Profile detection of an array of 8 cantilevers with SCALA.

Figure 3

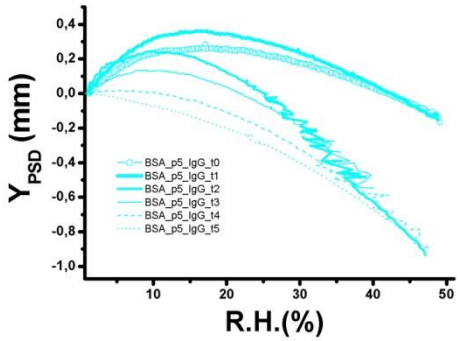

Figure3.Deflection measurement of the free-end of one cantilever showing how the peak response decreases with incubation time.