A novel biosensor platform integrating Love mode acoustic wave and surface plasmon resonance for the investigation of protein layers

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We have developed a novel biosensor that integrates in an unique platform two different sensing techniques: Love mode acoustic wave and surface plasmon resonance [1]. The platform allows for the determination of the physical properties of physisorbed layers of proteins onto a common sensing surface. It provides information related to the thickness, the water content and the adsorption kinetics of the protein layers.

At the heart of the integrated platform is the Love mode biosensor, a category of acoustic waveguide immunosensors with a high mass sensitivity for protein sensing in liquid media. Reported mass sensitivities of this sensor are in the range –100 to –950 cm^2/g for various material combinations [2]. The present Love mode biosensor is based on the classical structure of a quartz substrate with SiO_2 as guiding layer. The protein mass sensitivity was enhanced by two guiding layers: hydrogen-rich SiO_2 and gold. These layers present a low acoustic velocity leading to a better entrapment of the acoustic energy close to the sensing surface. The predicted theoretical sensitivity is –470 cm^2/g for 4 μm H-rich SiO_2. The effectiveness of the two layers approach is experimentally demonstrated on a packaged device with 1.2 μm H-rich SiO_2 and 50 nm gold that presented a calibrated experimental sensitivity of –260 cm^2/g for an acoustic wavelength of 40 μm.

The experimental set-up of the platform and its application to the investigation of collagen and fibrinogen protein layers is demonstrated. Its possible implementation to other suitable material combinations of the Love mode biosensor (i.e. quartz and lithium niobate substrates; silicon dioxide and PMMA coatings) is also discussed.

Keywords: acoustic waveguides, Love mode, surface plasmon resonance, proteins

References

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