
A Robust Microfabricated Field-effect Sensor for Monitoring Molecular Adsorption in Liquids

Personnel

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Sponsorship

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Molecular adsorption at the solid-liquid interface plays an important role in various areas of industry and research ranging from water purification systems to coatings for contact lenses and biomedical implants, up to state-of-the-art biosensors such as high-density DNA arrays and protein chips. In this project we are exploring the capabilities of silicon field-effect sensors for electrical monitoring of molecular adsorption. Field-effect detection provides direct access to interfacial parameters such as surface potential or surface charge densities and is well suited for parallel analysis of low sample volumes.

Figure 6 shows a field-effect sensor located at the terminus of a freestanding cantilever. The charge sensitive region, defined by lightly doped silicon, is embedded within the heavily doped silicon cantilever. Since both the electrical trace and sensitive region are passivated with thermally grown silicon dioxide, the entire cantilever can be immersed in buffer solutions and cleaned with strong acids without degrading its electrical response. As an example, we demonstrate that the device can reproducibly detect adsorption of positively charged poly-L-lysine on silicon dioxide (see Figure 7). The cantilever design allows independent chemical functionalization of each sensor which enables differential detection.

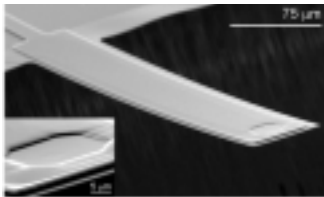


Fig. 6: Scanning electron micrograph of a field-effect sensor. Inset shows detail of sensor region.

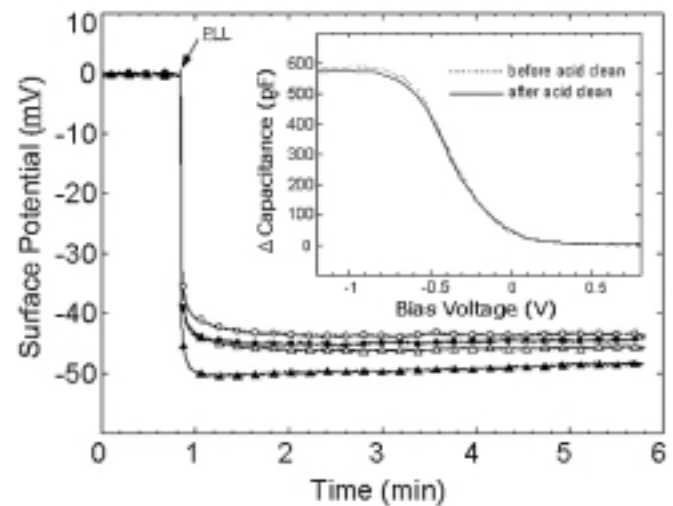


Fig. 7: Surface potential versus time during poly-L-lysine adsorption on the silicon dioxide sensor surface. After allowing the system to reach a stable baseline, the PLL solution was injected (arrow) in the fluidic chamber. Δ - sensor A, run 1. - sensor A, run 2. - - sensor B, run 1. - - sensor B, run 2. Inset shows capacitance vs. voltage characterization of 10000 mm² sensor region acquired in PBS buffer pH 7.5, showing response of the device before and after 60 s clean in piranha solution.