Covalently-bound organic monolayers for biosensor applications

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Abstract: In this paper, we present a detailed investigation on monolayer formation with thicknesses amounting 1 nm to 3 nm on silicon and silicon nitride surfaces. Thermal and photochemical methods are successfully used to form such stable and densely backed monolayers. Further, functionalisation of these surfaces with activated esters, amine groups are also presented. Static water contact angle measurements, atomic force microscopy (AFM), infrared reflection absorption spectroscopy (IRRAS) and x-ray photoelectron spectroscopy (XPS) are used to follow the progress of the reaction and final characterisation of the resulting surfaces. These monolayers can be further functionalised to link DNA and other biomolecules.

Keywords: silicon surfaces; organic monolayers; photochemical; biosensors; DNA; X-ray photoelectron spectroscopy; XPS; infrared reflection absorption spectroscopy; IRRAS; atomic force microscopy; AFM.

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1 Introduction

Devices capable of continuously and selectively detect biomolecular interactions are of great importance in biotechnology and medical diagnostics. For example, nucleic acid microarrays are used for expression profiling, genotyping, DNA sequencing, diagnostics, immunology and drug discovery. Nonetheless, there are still technical hurdles to overcome before biomolecular-based diagnostic devices will become widely available and reusable. Definitely, the improvement of DNA- and protein-based biosensors and microchips relies on the reproducible and effective immobilisation of biomolecules onto solid substrates. In this context, functionalisation of inorganic surfaces (silicon, silicon nitride and silicon carbide) (Arafat et al., 2004, 2007; Rosso et al., 2008, 2006) by