Biomolecules sensors and detection by surface science techniques.

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Abstract

Understanding of the reactivity and interaction of organic molecules on surfaces is of a great importance because its atomic arrangement determines the mechanical properties, electronic behaviour and reactivity of surfaces. Therefore, the ability to control and design the surface structure at a molecular level is a crucial point, so surfaces has attracted important attention due to their promising applications in nanotechnology and biotechnology. From these molecular units arise the possibility of complex functions like molecular recognition, sensing, electronic properties, conductivity, catalysis, chirality, magnetism and chemical reactivity that are important in nanoscience. Therefore, the adsorption, bonding and interaction of biomolecules, on surfaces is a necessary step towards the broad application of the interdisciplinary emerging field of nano-biotechnology. Interaction and reactivity of different biomolecules on well-controlled surfaces provide, for instance, convenient models to understand mechanisms in the formation of higher ordered molecular structures [1-2], strategies to functionalize large molecular based nanostructures for solid state advanced biosensors [3] or organic-inorganic platforms for new devices. To date, a majority of biomolecules adsorption studies have focused on adsorption on metallic surfaces such as those of copper, gold, silver, and stainless steel [4-6]; minerals can also be very promising surfaces for studying biomolecule-surface processes; among such minerals is pyrite.

Although various traditional methods exist to detect biomolecules, the development of innovative detection methods is therefore one of the major challenges in modern analytical sciences. The unique properties of some biomoleculas encourage the use of powerful and complementary surface science techniques for surface characterization and molecular detection, specifically techniques like X-ray Photoelectron Spectroscopy (XPS), Reflection Absorption Infrared Spectroscopy (RAIRS), Atomic Force Microscopy (AFM) and Scanning Tunnelling Microscopy (STM) [3,5,7]. By the complementary use of several techniques we will obtain information of molecule-surface adsorption, to improve our understanding of molecular self-organization processes. Furthermore, those techniques provide the possibility to optimise the sensing layer as well as to detect biomolecular recognition, which open promising ways to biotechnological devices.

The aim of the present research is to study the interaction of biomolecules, among them single amino acids, peptides and peptides nucleics acids (PNA) on metallic and mineral surfaces, and their chemical reactivity by means of powerful surface science techniques. We investigate surfaces chemical composition and molecular reactivity or recognition due to different nature, preparation or experimental conditions. A very important conclusion is that surface structure will dictate its molecular adsorption and reactivity properties. A delicate balance of experimental methodology helps us to control and drive molecular adsorption to the desire conditions. Additionally, surface science techniques are established as a powerful tool for molecular detection and recognition. These results present interesting consequences from a fundamental point of view, for the development of optimized biosensors and large number of bio-nano applications.

References

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Figures

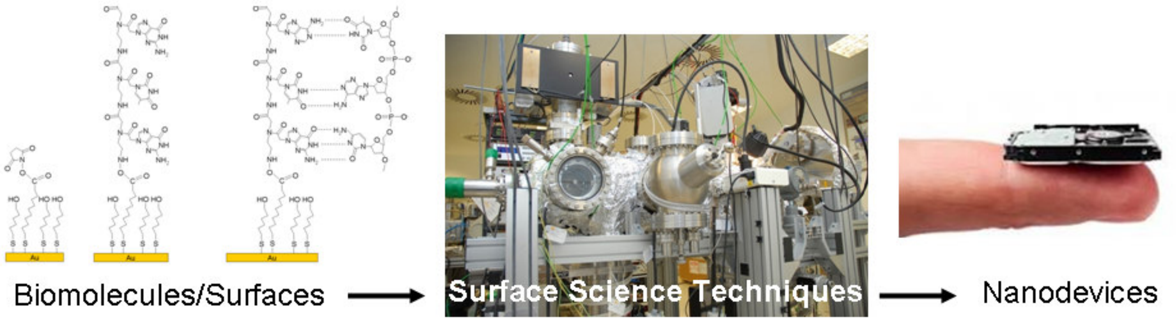

Figure 1: Schematic representation from biomoleculas on surfaces to nanodevices, through surface science techniques characterization.