

Using electrochemistry and self-assemblies for the controlled engineering of nanostructured biorecognition layers

Sandrin, L.⁽¹⁾, Basit, H.⁽¹⁾, Pedano, M. L.⁽¹⁾, Guérente, L.⁽¹⁾, Van Der Heyden, A.⁽¹⁾, Dumy, P.⁽¹⁾, Boturyn, D.⁽¹⁾, Renaudet, L.⁽¹⁾ and Labbé, P.^{(1)*}

(1) Département de Chimie Moléculaire, UMR CNRS 5250, Université Joseph Fourier, BP 53, 38041 Grenoble cedex 09, France

* Corresponding author: Pierre.Labbe@ujf-grenoble.fr

The controlled engineering of biorecognition layers is a key feature in the design of new tools for research in the field of medicine and life science. Biomolecules such as peptides, nucleic acids or carbohydrates can be immobilized on various transducing surfaces that can be used to understand how intermolecular interactions govern the recognition properties of living systems. This in turn can help in the rational design of new integrated functional systems applications such as drug targeting, molecular imaging, tailor-made medicine or new stimuli responsive biomaterials.

In this context, the development of non-fouling surfaces that resist the adsorption of proteins and/or the adhesion of cells is of fundamental importance in biotechnological fields such as biosensors, biocatalysis, bioanalytics and drug development. For these applications two criteria must be fulfilled. The surface must resist non specific adsorption while at the same time allowing immobilized biomolecular systems to preserve their specific binding properties. Although a tremendous research activity has been devoted for many years to the development of surface functionalization methods, there is still an enormous interest in devising versatile, reliable and reproducible technologies by which stable and well defined coatings can be prepared.

We will present a brief overview of the various surface coatings that have been examined for their reduced non-specific adsorption and improved specific recognition properties. Recently, we have developed the use of various functionalization strategies based on self-assembled monolayers, poly(ethylene glycol) (PEG) layers, supported lipid bilayers, click chemistry based –post functionalization for preparing biorecognition layers. These different approaches will be illustrated by several examples focusing on the impact of ligands multivalent presentation on several molecular recognition processes. We have developed peptide templates, termed RAFT that can be utilized to construct novel structures with integrated functions [1]. RAFT presents biomolecules in a multivalent mode to promote ligand-receptor interaction. Controlled immobilization of RAFT template on various surface transducers [2] allows quantifying enhanced avidity as well as more local subtle effects [3]. Other examples will concern the use of supported lipid bilayers as well as pegylated surfaces and click chemistry for studying cell adhesion processes or assembling stimuli responsive biomaterials [4]. In this context, electrochemistry is a particularly useful tool since this technique can be used non only to characterize surface composition and interfacial processes [2, 5], but also to detect sensing processes as in many sensors as well as to actuate stimuli-responsive devices.

References

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