SUPRAMOLECULAR INTERFACIAL ENGINEERING BASED ON CYCLODEXTRIN-MODIFIED SURFACES FOR BIOSENSOR APPLICATIONS

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Biosensor performance crucially depends on the proper functionalization of the transducer surface. The challenge is to properly design and engineer the surface functional groups in order to control the communication between the device and its bioenvironment. Strategies for biocomponent immobilization on electrodes include covalent attachment, physical adsorption and film deposition. The use of supramolecular interactions (i.e. host–guest interactions) is an attractive alternative to physical adsorption method as these interactions can be easily tuned by the appropriate selection of geometrically complementary host and guest molecules [1].
Cyclodextrins (CD) are a family of cyclic supramolecular receptors composed of glucopyranose units featuring a central hydrophobic cavity that allows the inclusion of several types of guest molecules of appropriate size to form inclusion complexes. Here we report two novel strategies for biosensor fabrication based on complementary supramolecular interactions between guest-appended proteins and cyclodextrin-modified electrodes.
The first strategy consists in the immobilization of a first layer of thiolated cyclodextrin polymer on a gold electrode followed by the supramolecular capture of adamantane-modified enzymes [2]. Successive enzyme layers are then attached using CD-modified gold nanoparticles (Au-CD) as supramolecular linkers, which due to their spherical shape provide the appropriate directionality to the supramolecular interactions. Layer-by-layer deposition has been studied by surface plasmon resonance, cyclic voltammetry and impedance spectroscopy and employed in the construction of amperometric biosensors (Figure 1).

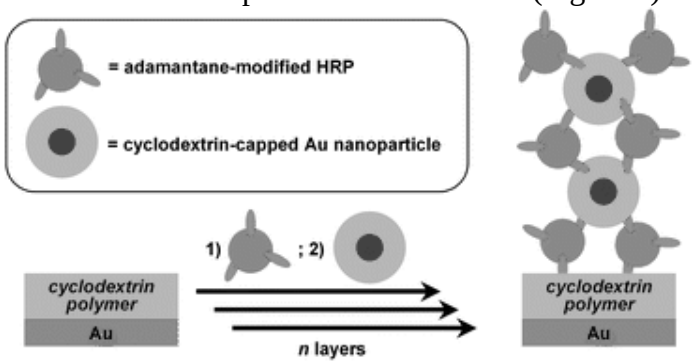

Figure 1. Layer-by-layer self-assembly of enzymes on gold electrodes based on complementary cyclodextrin–adamantane supramolecular interactions

The second strategy consists in the cyclodextrin modified surfaces as platforms for the immobilization of antibodies. The antibodies are covalently immobilized on adamantane-appended carriers based on biocompatible polysaccharides and deposited onto the cyclodextrin-modified electrodes (Figure 2). This architecture was employed in the construction of an immunosensor for the detection of celiac disease related targets.

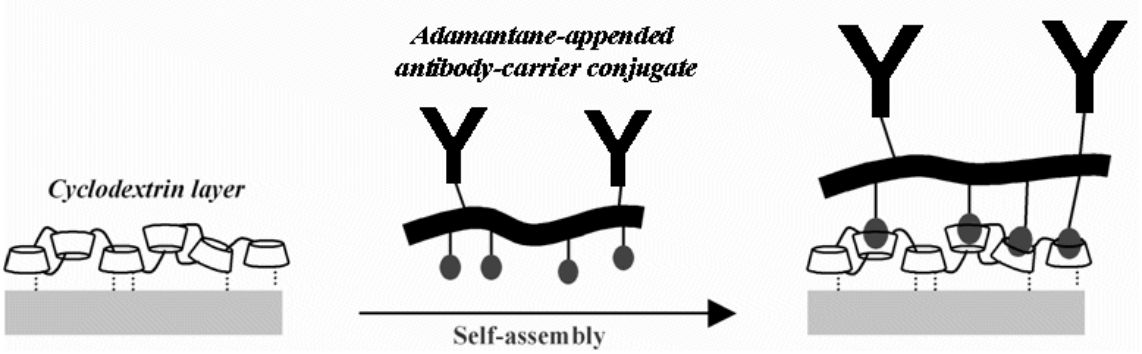

Figure 2. Immobilization of antibodies on electrode surfaces via supramolecular interactions.

References:

[1] Villalonga, R., Cao, R., Fragoso, A. Chem. Rev. 107 (2007) 3088.
[2] Fragoso, A., Sanroma, B.; Ortiz, M.; O'Sullivan, C. K. Soft Matt.5 (2009) 400.