Development of nanomaterial-based electrochemical biosensor for chronic inflammatory airways disease monitoring

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Electrochemical Biosensors

Concept

Nowadays there is a growing interest in the development of innovative approaches to quantify a specific biomarker in biological fluids in order to monitoring inflammatory diseases.
This project will focus on *eosinophilic asthma*. Asthma is a heterogeneous disease that causes chronic airways inflammation. Quantification of specific biomarker could be useful to phenotype asthmatic patient and develop personalized drug treatment. However, the measurement of multiple biomarkers is not included in current clinical practice because it requires laboratories, highly skilled personnel , high costs and long time analysis. Therefore, it is necessary to identify novel, cheaper, faster and easy to use methods. Electrochemical biosensors are a promising alternative to the conventional standard ELISA (Enzyme-Linked Immunosorbent Assay) in terms of detection time, accuracy, and cost. Hence, the research project aims to develop an electrochemical immuno-sensor.

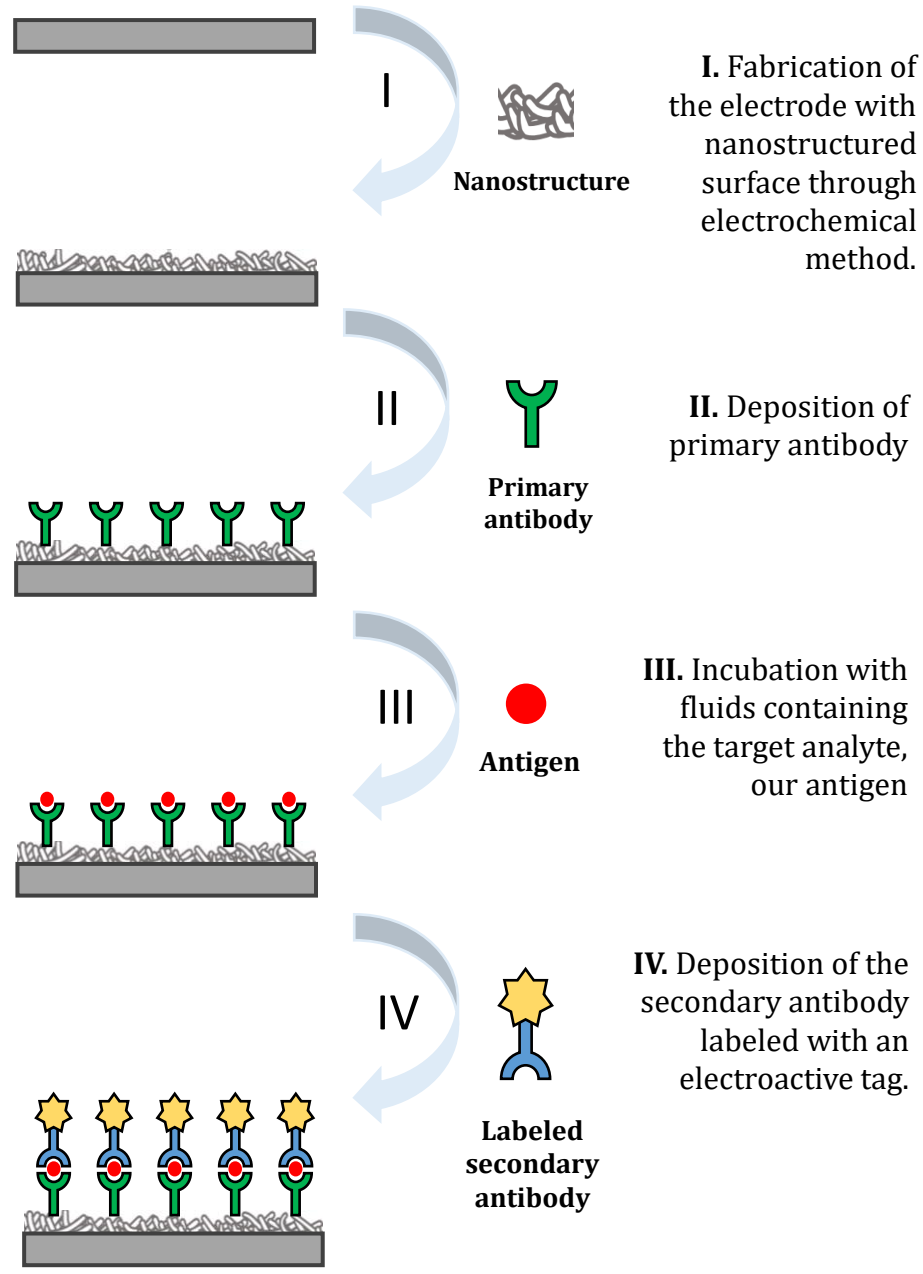
Scientific approach

An immunosensor is a type of biosensor in which a specific target analyte, antigen, is detected by formation of a stable immunocomplex between antigen and antibodies. This complex results in generating a measurable electrical signal given by a transducer. As in ELISA test, we will create "sandwich" structure (shown in figure IV) on the surface of the electrode and the electrical signal will be generated thanks to redox reactions of an electroactive substance, as enzyme, chemical compounds or nanoparticles.
Immunoglobulin G (IgG) will be used as model protein. Then, since we focus on *eosinophilic asthma*, we will find the most suitable protein as asthma biomarker and use it as antigen.
Nanomaterial technology will be exploited to obtain a high sensitive sensors. Nanostructured materials, such as nanowires or nanoparticles, show high chemical reactivity and novel optical, electrical and magnetic properties. All these features make such materials promising for the development of high performance sensors.

Research objectives

The research project aims to develop an electrochemical immunosensor for the detection of biomarkers of inflammatory diseases with a focus on *eosinophilic asthma*. In order to fabricate the electrode, different nanostructured (nanowires, nanoparticles and magnetic beads) materials (such as gold, graphene) will be used as electrochemical sensor platform. These studies will lead to the fabrication of a cheap and fast device that could improve the life quality of asthmatic patient.

Sensor fabrication



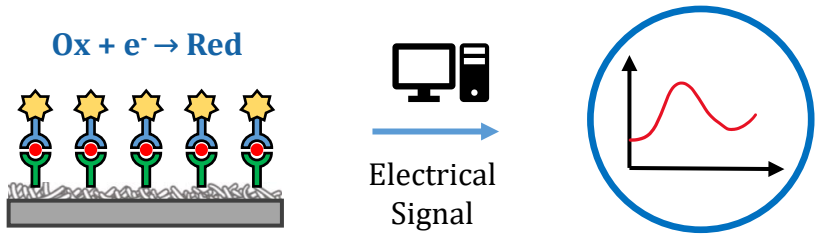
I. Fabrication of the electrode with nanostructured surface through electrochemical method.

II. Deposition of primary antibody

III. Incubation with fluids containing the target analyte, our antigen

IV. Deposition of the secondary antibody labeled with an electroactive tag.

Analyte detection



The electroactive tag, for example an enzyme, catalyse a redox reaction generating a detectable electrical signal that can be linked to analyte concentration through a calibration curve.