Electrochemical Impedance Spectroscopy of lipid bilayers cushioned on doped silicon surfaces

Lukasz Poltorak[1], Louis C.P.M. de Smet[1,2] and Ernst J.R. Sudhölter[1]

(1) Delft University of Technology, Department of Chemical Engineering, Organic Materials & Interfaces, Van der Maasweg 9, NL-2629 HZ Delft
(2)Wageningen University & Research, Laboratory of Organic Chemistry, Stippeneng 4, NL-6708 WE Wageningen

Platforms bridging electronic devices with biological systems attracts considerable attention due to its relevance in number of applications, including drug screening, electroanalytical sensing, risk evaluation, bioinspired energy conversion. Silicon semiconductors, among other transducing electronic components, are materials with well-understood and developed manufacturing process that allows miniaturization down to nanometer level [1]. Moreover, the chemistry of (oxidized) silicon enables straightforward functionalization leading to desired and tunable surface properties [2]. Both aspects are essential from an electroanalytical point of view since miniaturizations leads to higher mass transport (higher sensitivity), increase the surface-to-volume ratio and usually enhance the mechanical stability of the system. On the other hand, surface functionalization allows the design of the surface properties in such a way that the sensor becomes specific towards particular analytes or/and allows the adjustment of surface physicochemical properties.

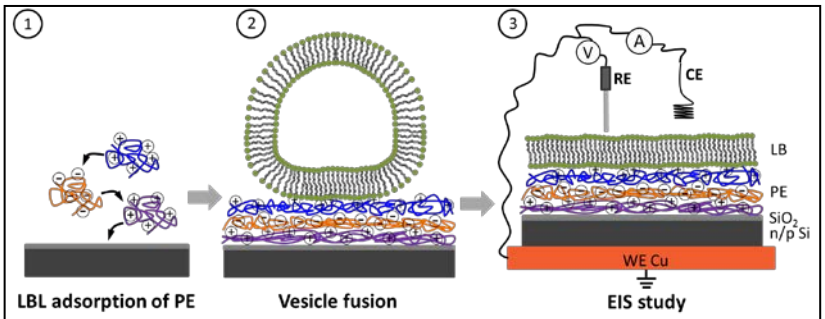

Figure 1. Schematic representation of the experimental approach. **(1)** Layer-by-layer deposition of oppositely charge polyelectrolytes. **(2)** Phospholipid vesicle fusion onto the polyelectrolyte multilayer cushion. **(3)** Formation of a supported lipid bilayer and its study with electrochemical impedance spectroscopy. Abbreviations stand for: **LB** – lipid bilayer; **PE** – polyelectrolytes; **LBL** – layer-by-layer and **n/p Si** is the n- or p- doped silicon wafer with thermally grown SiO_2 on its surface.

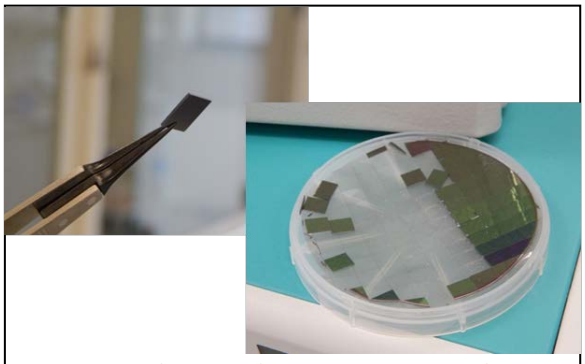

Figure 2. Set of silicon wafers used to create biointerface.

In the section of **Organic Materials & Interfaces (OMI)** we are developing the biointerface shown in Figure 1. First the polyelectrolyte cushion, prepared by the layer-by-layer deposition of oppositely charged polyelectrolytes (poly(ethylenimine); poly(styrene sulfonate) and poly(allylamine)) is adsorbed on **n-** or **p-doped silicon** (Si) supports (Figure 2). Next, **lipid vesicles** composed of cationic or anionic or zwitterionic phospholipids are fused on the **multilayered polyelectrolyte cushion** to form a **lipid bilayer (LB)**. Previously we have shown that the adsorption of polyelectrolytes affects the impedimetric properties of the doped Si under weak depletion conditions [3]. This work aims to understand the electric properties of n- and p-doped Si in the presence of LBs cushioned with polyelectrolyte multilayers under depletion and accumulation conditions. Further incorporation of ion channels/ions pump and finally miniaturization of the system will be assessed as potential electrochemical sensor of ions.

REFERENCES

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