ELECTROCHEMICAL CHARACTERISATION OF MIXED SILANE BASED SELF-ASSEMBLED MONOLAYERS FOR PHOSPHOLIPID MEMBRANE BILAYER FORMATION

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Biological lipid membrane mimicking systems are convenient subject for investigating interactions between enzymes, toxins, other proteins and biological membranes. Such systems were designed as membranes on solid supports. They are physically stable enough and they could be investigated using different surface sensitive methods, such as various electrochemical methods, surface plasmon resonance or atomic force microscopy.

So far, such system was designed on gold substrate with alkanethiol self-assembled monolayers (SAM) and widely investigated [1]. Even though such system shows great properties but it has some flaws. Gold is expensive material and to fabricate thin films one needs expensive devices. Additionally, atoms on the Au surface are mobile, so Au–SH bond is mobile across the substrate. After being in a contact with aqueous solution, SAM reassembles into islands and it is no longer uniform. This leads to a system which could be used only one time [2].

In this study, inexpensive and commercially available fluorine doped tin oxide was functionalized with octadecyltrichlorosilane (OTS), methyltrichlorosilane (MTS) and vinyltrimethoxysilane (VTS) self-assembled monolayer (SAM). OTS-MTS and OTS-VTS were mixed at different molar ratios to produce anchoring SAM for phospholipid membrane formation via vesicle fusion method. Vesicle solution contained 60 mol% 1,2-dioleoyl-sn-glycero-3-phosphocholine (DOPC) and 40 mol% cholesterol (Chol) while total lipid concentration was 1.5 mM.

To investigate SAM and membrane, contact angle (CA), cyclic voltammetry (CV) and electrochemical impedance spectroscopy (EIS) methods were used. From recorded EI spectra presented in Cole – Cole and Bode plot it is possible to make assumptions about surface coverage with SAM, calculate number of defects [3]. After analyzing CA, CV and EIS results, SAM and bilayer formation was attested. Obtained results were comparable with developed system of Au/SH [4]. Three different proteins were able to penetrate formed phospholipid membrane system and confirm the biological activity.

To conclude, biologically relevant membrane was formed on OTS-VTS and OTS-MTS monolayers. In near future, such systems could be successfully applied for protein investigation, such as toxin detection or analyzing electron transfer proteins.

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