

## Novel surface architectures for biomimetic lipid membranes

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**INTRODUCTION:** Many important biological processes occur at, via or across one of the various lipid membranes present in the cell. Designing and controlling self assembly of model membranes onto sensor substrates thus constitutes an important field of research, enabling applications in e.g. drug screening, dynamic biointerfaces and artificial noses.<sup>1</sup>

We present how mimics of bacterial membranes with applications in antibiotics research can be self-assembled at common biosensor interfaces. Results are also presented on the assembly of poly(L-lysine)-graft-poly(ethylene glycol) (PLL-g-PEG) cushioned lipid membranes for incorporation of large transmembrane proteins on any substrate with negative surface charge.

**METHODS:** Quartz crystal microbalance with dissipation monitoring (QCM-D, Q-Sense, Sweden) and Optical Waveguide Lightmode Spectroscopy (OWLS, MicroVacuum, Hungary) experiments were conducted to follow the adsorption kinetics. The complementary nature of the techniques is used to deduce conformation and conformational changes of the supramolecular assemblies.<sup>2</sup> To further verify formation of planar supported lipid bilayers (SLB) fluorescence recovery after photobleaching (FRAP) was used. Experiments were performed using bath sonicated large unilamellar lipid vesicles (LUV) and PLL-g-PEG with the PEG functionalized with N<sup>+</sup>-C<sub>12</sub>H<sub>25</sub> “biocide” molecules synthesized in-house.

**RESULTS:** We show that bacterial lipid membrane mimics of varying degrees of complexity, POPC:POPG (2:1), POPE:POPG (2:1) and E. Coli total lipid extract lipid mixtures (Avanta Polar Lipids, USA), can be self-assembled from LUV onto relevant biosensor materials like TiO<sub>2</sub> and SiO<sub>2</sub> by tuning the concentration of Ca<sup>2+</sup> ions in a narrow interval up to 2 mM.

We furthermore demonstrate that by tuning the density of “biocide” the capture and deformation of LUV at the interface can be controlled. By adding a trigger step consisting of addition of 30% (v/v) of PEG(8000) the LUV are made to rupture and fuse into a polymer-supported SLB.

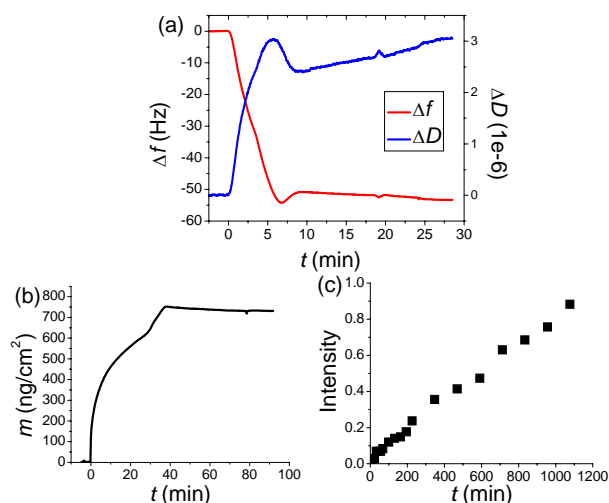


Fig. 1: (a) QCM-D adsorption curve for E. Coli LUV on TiO<sub>2</sub> at 1 mM CaCl<sub>2</sub>. (b) OWLS adsorption curve. (c) FRAP recovery data.

**DISCUSSION & CONCLUSIONS:** While the formation of bacterial mimic SLBs is conclusively demonstrated the results highlight the need for using complementary methods when studying supramolecular assemblies, as demonstrated by the data collected in Fig. 1. A further analysis of e.g. these results indicates formation of an undulating rather than a planar SLB tethered to the surface.

Both the bacterial membrane mimics and the PLL-g-PEG-supported SLB are compatible with a large range of biosensing techniques and through the use of sequential adsorption and rupture steps the PLL-g-PEG-supported SLB is not sensitive to e.g. roughness, charge or other properties of the underlying substrate.

**REFERENCES:** <sup>1</sup>S. Daniel, F. Albertorio, P.S. Cremer (2006) *MRS Bulletin*, **31**(7):536-540. <sup>2</sup>E. Reimhult, B. Kasemo and F. Hook (2004) *Anal Chem*, **76**(24):7211-7220

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