CHARACTERIZATION AND BIOLOGICAL APPLICATIONS OF SELF-ASSEMBLED DITHIOTHREITOL ON AU SURFACES

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Supported lipid membranes on the surface of metallic substrates are promising structures for biological applications. However, these surfaces need to be modified in order to allow the self-assembling of the lipid layer. The modification of gold surfaces, for example, with organic molecules that act as spacers to link macromolecules such as phospholipids provides a biomimetic system where hydrophilic domains can accommodate proteins and make available studies of charge transport through this complex system (1-3).

In this work we have studied the surface and electrochemical properties of a well order (111) and polycrystalline Au substrates modified with dithiothreitol (DTT), incubated at room temperature and at 60°, in order to elucidate the possible configurations of the molecules for subsequent growth of lipidic bilayers by vesicle fusion.

The self-assembly of dithiothreitol (DTT) on Au(111) from solution deposition has been studied by X-ray photoelectron spectroscopy and electrochemical data. DTT molecules self-assemble on Au(111) in a lying down configuration irrespective of the concentration and temperature. XPS and electrochemical data indicate a DTT surface coverage of $\theta \approx 0.16$ with two S head-Au covalent bonds per DTT molecule. The DTT monolayer turns the Au surface hydrophilic allowing the formation of fluid dimyristoylphosphatidylcholine (DMPC) bilayer domains by vesicle fusion as revealed by in situ atomic force imaging (AFM).

The Figure 1 shows a sequence of images obtained for lipid bilayers on top of an Au polycrystalline layer incubated with DTT and the Figure 2 illustrates the multilayered structure with Methylene Blue (MB) and Flavin Adenine Dinucleotide (FAD), which are probes for transport studies across the membrane, and corresponding response under electrochemical measurements.

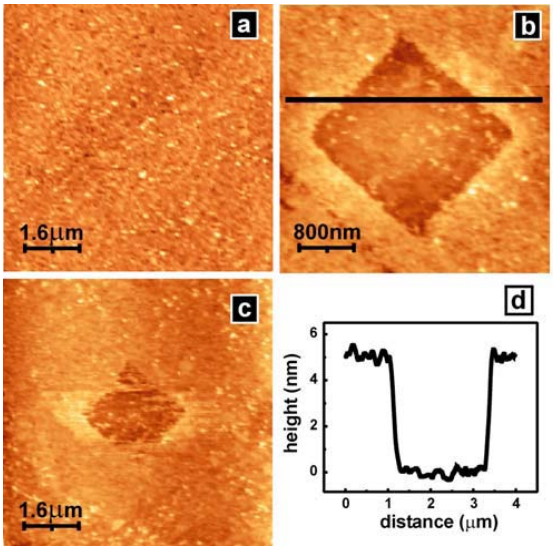

Figure 1. AFM images of DMPC bilayer formed on a lying down DTT SAM formed on polycrystalline gold. a) Large covered area with a lipid layer. b) Square window defined by the removal of the lipid layer using the AFM tip. c) DMPC layer recovering the surface of the square window. d) Cross section profile corresponding to the black line of image b).

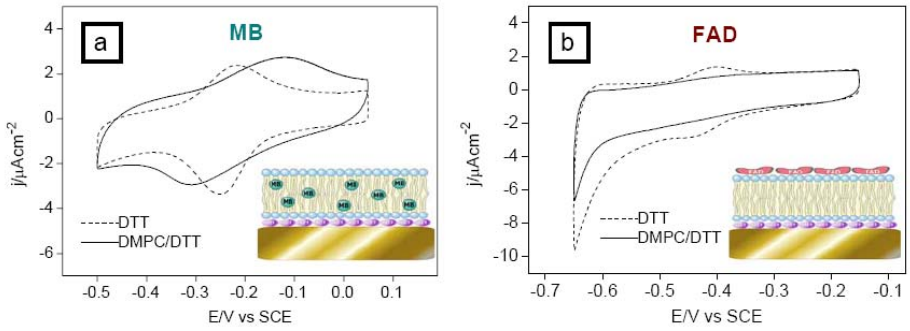

Figure 2. Selective permeation of biomolecules. Cyclic voltammograms performed in phosphate buffer 0.1 M pH 7.0 at scan rate: 50 mV/s. Full lines correspond to voltammograms for DMPC bilayer-DTT-Au (111) substrates incubated 30 min either in MB 0.1 mM (a) or FAD 0.1 mM (b) aqueous solution to immobilize these molecules. Dotted lines correspond to the voltammograms recorded for DTT-Au(111) electrodes subjected to the same procedure.

References:

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