40d Soft Supported Biomimetic Membranes: Assembly and Performance

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In general, all the biological processes that take place in living organisms are intimately linked to cell membrane phenomena. However, the complexity of such cellular membranes is an issue that has to be faced. A cell membrane is basically composed by a mixture of 3 types of phospholipids which are phosphoglycerides, sphingolipids, and sterols. These phospholipids form a bilayer, which is the matrix that sustains the equilibrium inside and outside the cell. Different types of proteins are imbibed in the phospholipids bilayers that allow the cell to interchange ions and fluids with the exterior. Our work is focused on the construction and study of biomimetic membranes in a controlled manner, starting up from simple systems (i.e., bare lipid bilayers) to gradually adding elements that are part of real cells, such as multiple lipids, proteins, cholesterol, and fatty acids among others. The purpose of this work is to characterize the individual contribution of each element and construct very well-defined model membranes that allow one to evaluate new drug testing, electroporation, impedance studies, and the response to biosensors among other applications. The assembly of biomimetic cell membranes is first done by depositing and activating a thin film of silica (i.e., to create surface silanol groups). This film is then reacted with polyethylene glycol (PEG), which is a biocompatible polymer, to create a cushion-like layer that supports and allows the lipid bilayer to have high mobility. A lipid bilayer is then deposited on this soft support to reproduce a cell membrane using the Langmuir Blodgett deposition technique. The progressive formation of lifelike membranes is done by inserting the mentioned elements following the method of Bangham. The characterization of such biomimetic membranes has been studied by using Atomic Force Microscopy (AFM) and the Surface Forces Apparatus (SFA) in liquid environments. Our results show that these lipid bilayers are highly mobile and exhibit a particular behavior depending on the individual contribution and ratio of these elements with respect to the lipid volume in the model membrane. For instance, the SFA measurements have provided unique information on the behavior of lipid bilayers and amyloid beta (Aß) peptide interactions, which is relevant to Alzheimer's disease research. In this case, we have been able to compare the adhesion mechanisms of Aß peptides to soft and mobile model membranes and to rigid membranes. We have found that peptide adhesion is indeed enhanced in rigid surfaces. The final goal of this project is to perform diverse in vitro studies to facilitate the understanding of complex mechanism such as transport across membranes, cell fusion, cell adhesion, and interactions with proteins under different environments to reproduce biological functions that may elucidate the physiology of cellular diseases.