MAR16-2015-007901

Abstract for an Invited Paper
for the MAR16 Meeting of
the American Physical Society

Functional, Responsive Materials Assembled from Recombinant Oleosin.

DANIEL HAMMER, University of Pennsylvania

Biological cells are surrounded by a plasma membrane made primarily of phospholipids that form a bilayer. This membrane is permselective and compartmentalizes the cell. A simple form of artificial cell is the vesicle, in which a phospholipid bilayer membrane surrounds an aqueous solution. However, there is no a priori reason why a membrane needs to be made of phospholipids. It could be made of any surfactant that forms a bilayer. We have assembled membranes and other structures from the recombinant plant protein oleosin. The ability to assemble from a recombinant protein means that every molecule is identical, we have complete control over the sequence, and hence can build in designer functionality with high fidelity, including adhesion and enzymatic activity. Such incorporation is trivial using the tools of molecular biology. We find that while many variants of oleosin make membranes, others make micelles and sheets. We show how the type of supramolecular structure can be altered by the conditions of solvent, such as ionic strength, and the architecture of the surfactant itself. We show that protease cleavable domains can be incorporated within oleosin, and be engineered to protect other functional domains such as adhesive motifs, to make responsive materials whose activity and shape depend on the action of proteases. We will also present the idea of making "Franken"-oleosins, where large domains of native oleosin are replaced with domains from other functional proteins, to make hybrids conferred by the donor protein. Thus, we can view oleosin as a template upon which a vast array of designer functionalities can be imparted..