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Polymer/lipid assemblies in constrained geometry

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Abstract: Interfacial characterization of phospholipid assemblies and their interaction with macromolecules will be described for two topics: (i) supported lipid bilayers stabilized by telechelic lipopolymer cushions and (ii) vesicles tethered to supported bilayers. In the first theme, polymer conformational transitions at the air-water interface have been predicted by deGennes scaling theory, and Langmuir-Blodgett transfer has been optimized to deposit homogeneous monolayers with ideal transfer ratios, with uniform bilayer formation being demonstrated using both fluorescence microscopy and atomic force microscopy. Lateral mobility of the lipids in the distal leaflet of the polymer-tethered bilayer was a function of only the tethering density, not the polymer conformation. In the second theme, we have demonstrated that our tethered vesicle assembly process is robust and reproducible. In particular, the biotin-streptavidin coupling scheme that localizes the vesicles at the supported bilayer may be accounted for quantitatively. General conclusions are that synthetic biomembranes may be fabricated through a variety of routes, but an essential feature for the polymer-supported lipid bilayers is that the tethering polymer be terminally functionalized. An understanding of the interfacial physics associated with the fabrication of these supramolecular assemblies requires coordinated application of numerous analytical techniques to establish structure and state of organization.

Dr. Frank received his PhD in Chemical Engineering from the University of Illinois in 1972 and then worked at Sandia National Laboratories in Albuquerque, New Mexico until 1976 when he moved to Stanford University as an Associate Professor in the Department of Chemical Engineering. He was promoted to Full Professor in 1985 and received the endowed William M. Keck Sr Professorship in 1994. Also in 1994, he co-founded the Center on Polymer Interfaces and Macromolecular Assemblies, a Materials Research Science and Engineering Center supported by the National Science Foundation. In 2009 Frank became the Senior Associate Dean for Faculty and Academic Affairs in the School of Engineering. His research interests are currently focused on characterization of interpenetrating network hydrogels for biomedical applications, study of polymer-lipid assemblies for bioanalytical devices, and the materials science of biodegradable polymers.

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