Amgen Seminar Series in Chemical Engineering

in

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Squishy Lipid Structures - From Nanomaterials to Vaccine Delivery

by

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Lipids and synthetic surfactants exhibit a fascinating variety of self-assembled microstructures when dissolved in organic and/or aqueous phases. The novelty of these systems is the ordering of structure over multiple length scales and the fact that organic and aqueous phases can be compartmentalized with inherent order. The synthesis of nanomaterials within these compartmentalized systems becomes a real possibility, especially with regard to cosynthesis of hydrophobic and hydrophilic materials.

In this talk, I will start with a description of the range of microstructures formed when a twin tailed ionic surfactant (AOT) is mixed with a phospholipid (lecithin). These systems can solubilize almost equal volumes of water and a hydrocarbon while existing in crystalline mesophases. We explore the use of small angle neutron scattering (SANS) to characterize the mesophases and to understand structural transitions. We then show how traditional polymer processing techniques (extrusion and Couette shear) can be used to align these mesophases over multiple length scales. We have developed 31P NMR techniques to characterize mesophase microstructure and alignment, thus complementing SANS. In applications, we show how these mesostructures can be used in making polymeric and ceramic nanomaterials. And in more recent research, we show how these synthetic systems can help us understand and control lipid microstructures in the stratum corneum to allow permeation of vaccine antigens. The development of new patch technology for vaccine delivery will be described.

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