

SOLUTIONS WITH STRUCTURE FOR CELLULAR DELIVERY

Cecilia Leal, Materials Science and Engineering, University of Illinois at Urbana-Champaign

Lipid liquid crystalline materials having nanostructures that deviate from the conventional flat bilayer arrangement such as 2D hexagonally packed lipid tubes and bicontinuous cubic phases have been increasingly recognized as relevant materials for the applications of gene and drug delivery, as well as linked to the functionality of organelle membranes. The simple argument that non-lamellar phases have higher surface-to-volume ratios enabling more point contacts with cell surfaces while having a larger encapsulation power to host drug/gene molecules might be insufficient to completely describe the experimental findings.

In this presentation we will show our recent efforts to stabilize topologically active lipid-based colloidal dispersions as well as thin films incorporating bioactive molecules for cellular delivery. We combine i) Small/Wide Transmission/Grazing Incidence X-ray Scattering, ii) Cryo-Electron Microscopy, and iii) Cell Culture methods to demonstrate that a judicious choice of lipid materials allows an incredibly rich phase behavior in bulk, solution, and thin film platforms. Furthermore, the systems can be tailored to be adaptive in response to a number of environmental cues. The general finding is that lipid-based materials comprising negative Gaussian curvature membranes are able to most efficiently deliver their cargo across cell membranes by lowering the energy cost of forming a membrane pore.