CHEMISTRY Departmental Seminar

Spring 2018
CHEM 285 Schedule
Tuesdays at 4:30-5:45PM
Room Duncan Hall 250

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Frustration-Induced Periodic Pattern Formation by Minimally Hydrated Molecular Amphiphiles

Minimally hydrated amphiphiles self assemble into spatially periodic lyotropic liquid crystals (LLCs) with nanoscale aqueous and hydrophobic domains. Well-known LLC morphologies include 1D lamellae, 2D columnar phases, 3D bicontinuous networks, and high symmetry 3D sphere packings. Extrapolating from hard sphere packings, one intuitively anticipates that spherical micelles should form high symmetry body-centered cubic (BCC), face-centered cubic (FCC), and hexagonally close-packed (HCP) structures. However, we recently discovered that ionic surfactant micelles can also spontaneously form low symmetry, tetrahedrally close-packed Frank-Kasper σ and A15 phases, and related C14 and C15 Laves phases, with gigantic unit cells that mirror the structures of well-known intermetallic compounds. These new, low symmetry phases arise from a frustrated non-covalent force balance that minimizes local variations in amphiphile solvation, while maximizing global micelle cohesion across the ensemble. We will also discuss how surfactant structure dictates lyotropic sphere packing symmetry selection and the underlying thermodynamic stabilities of these complex assemblies. This work suggests that frustration at competing length scales drives periodic pattern formation at length scales that far exceed those of their constituent molecular and supramolecular building blocks.

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