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Electrostatic self-assembly of biomolecules[1]

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Charged filaments and membranes are natural structures abundant in cell media. In this talk we discuss the assembly of amphiphiles into biocompatible fibers, ribbons and membranes. We describe one- and two-dimensional assemblies that undergo re-entrant transitions in crystalline packing in response to changes in the solution pH and/or salt concentration resulting in different mesoscale morphologies and properties. In the case of one-dimensional structures, we discuss self-assembled amphiphiles into highly charged nanofibers in water that order into two-dimensional crystals. These fibers of about 6 nm cross-sectional diameter form crystalline arrays with inter-fiber spacings of up to 130 nm. Solution concentration and temperature can be adjusted to control the inter-fiber spacings. The addition of salt destroys crystal packing, indicating that electrostatic repulsions are necessary for the observed ordering. We describe the crystallization of bundles of filament networks interacting via long-range repulsions in confinement by a phenomenological model. Two distinct crystallization mechanisms in the short and large screening length regimes are discussed and the phase diagram is obtained. Simulation of large bundles predicts the existence of topological defects among bundled filaments. Crystallization processes driven by electrostatic attractions are also discussed.

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