Understanding the structure and structure-property-function relationship is key for the development of new functional materials. Structural analysis of multiscale soft systems may, however, be limited due to the 'invisible' complexity of the structures. Cryo-electron microscopy (CryoEM) techniques which comprises cryo-TEM and cryo-SEM are non-invasive methods that enable direct detection of soft suprastructures in solution at their hydrated state, at multiple length scales, and at high resolution. Additionally, analysis is done directly, i.e., without the need for a pre-determined model or post-imaging analysis. Cryo-TEM, for example, is highly effective for resolving the coexistence of multiple nanostructures and short-lived intermediates [1], thus providing particle-specific unique data that cannot be obtained from techniques such as scattering or rheology that probe bulk properties. Cryo-SEM covers a wide scale of structures and can readily be applied to highly viscous systems. Combined with another CryoEM method, Cryo-Tomography, one can resolve the detailed spatial organization in 3 dimensions.

This talk will focus on characterization of soft molecular matter systems by CryoEM techniques, and will emphasize analysis of molecular gels and 1-dimensional structures, with examples from our recent works with surfactants, lipids, peptides and proteins.

Figure 1. Cryo-TEM analysis of entangled and branched micellar networks

References: