Supracolloidal association of microgels and supramolecular tubules of bile salt derivatives

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The aggregation of colloid-sized particles is a fascinating subject, widely employed in chemistry, physics, and biology. The formation of supracolloidal nanostructures represents nowadays an intriguing approach for building novel artificial nanomaterials and devices. In general, to master a fine control over the interactions of colloidal particles is fundamental when approaching complex structures. This control is particularly crucial when involving systems of particles of different shapes, where specific interactions can be exploited to provide complex supracolloidal geometries with expanded application potential. With this background, we have studied supracolloidal aggregation between spherical microgels and supramolecular surfactant tubes. The interactions were controlled by changing charge of the particles and parameters such as electrolyte concentration and temperature. We used cationic or anionic microgels and catanionic surfactant tubes with tunable charge, which were formed in mixtures of anionic and cationic derivatives of bile salts. The charge of the tubes was controlled by changing the anionic/cationic derivative molar ratio. A structure of triangular rolled layer was observed for the catanionic tubes; with the edges of the layer creating a spiral pattern along the tubular walls. Tubes with a smooth surface were instead formed in the self-assembly of only the anionic derivative. We demonstrate in this work that the microgels interact specifically to the edges of the layers that form the tubular structures. By properly choosing the tube type and adjusting the interaction conditions, virus-like particles, microgel-decorated tubules or clusters of tubes interconnected by microgels were formed (Figure 1a, b and c, respectively). Extended forms of these clusters provide a basic framework of new low-density hybrid gels.