From coffee mugs and doughnuts to complex soft matter nanostructures

Jun.-Prof. André H. Gröschel, Physikalische Chemie, Universität Duisburg Essen

The bottom up construction of materials through the self-assembly of smaller building blocks is omnipresent in nature and materials science. For instance, the capsids of nanoscale viruses are constructed from multiple identical protein subunits resulting in complex surface structure and function. Designing complex soft nanoparticles with nanoscale structural resolution is an exiting field, yet also requires concepts to tune the interaction of building blocks as well as their reliable positioning on the few nanometer scale. The Gröschel Group searches for new routes to self-assemble complex shapes and forms of soft matter, where one approach could be to exploit the topology of nanoobjects to generate surface patterns with specific geometry.

This lecture reviews recent developments in topologic soft matter and aims to combine block copolymer microphase separation with topological defects to create predefined patterns on soft nanoparticles. Two particularly potential routes are discussed in more details, which are the sequential collapse of ABC triblock terpolymers in solution and the polyion-induced microphase separation of polymer brushes tethered to spherical colloids. The delicate surface structures are analyzed by cryogenic transmission electron microscopy (cryo-TEM) and tomography (cryo-ET), where especially the latter provides deep structural insight into the 3D arrangement of the polymeric phases.