Order from Chaos: the Art and Science of Nanoself-Assembly

Self-assembly—the autonomous organization of components into structures or patterns as a result of specific local interactions—is a governing principle by which materials form. The complex structures arising from self-assembly are abundant in nature, from viral capsid organization to collagen self-assembly. We are on the verge of a nanomaterials revolution in which entirely new classes of artificial anisotropic nanoparticles and molecules will be designed and synthesized every year and these new building blocks will be the atoms and molecules of tomorrow's materials. Therefore, we are in urgent need of new approaches to efficiently self-assemble these new building blocks into I) programmable architectures and II) complex topologies to create novel properties.

Note that synthesis of complex topologically structures like multi-twist, braid, and coil in the range of nanometer to few micrometer is still very challenging, both intellectually and technically. This is because the successful design and construction of topological structures at such small dimensions requires controllable generation of nodes at precise position and time and with the correct handedness. This is the main reason topologies such as braids and twills do not exist naturally.

In my talk, I will first introduce the new anisotropic nanoparticles that I have made in the past few years and then I will explain the evaporation-mediated and the DNA-mediated self-assembly of these nanoparticles into novel 2D and 3D architectures, respectively. I will finish my talk explaining the new exciting method that I have developed to self-assemble filamentous materials into multi-twist, braid and twill topologies, each step with higher degree of complexity.

Biography

Dr. Mohammad Shahjamali earned a Ph.D. in Materials Science from Nanyang Technological University, Singapore under the mentorship of Prof. Freddy Boey. In 2013, Dr. Shahjamali moved to the laboratory of Prof. Chad Mirkin at Northwestern University where he studied DNA-mediated self-assembly of anisotropic nanoparticles. From July 2015, he joined the School of Engineering and Applied Sciences at Harvard University and he is currently a research associate working with Prof. David Weitz and Prof. Vinothan Manoharan.

Dr. Shahjamali research interests lie in the area of chiral self-assembly, nontrivial topology at nanoscale, DNA origami assembly, bio-inspired materials and light matter interaction. He has collaborated actively with researchers in several other disciplines of materials science, particularly chemical engineering, bioengineering, chemistry and physics.