

Not Just About Shapes: How Anisotropy Shapes the World of Soft Materials

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Soft materials are ubiquitous in nature, commercial products and industrial processes. They are often comprised of spherical particles in a solvent. Interestingly, both single particle anisotropy and confinement effects can significantly impact the behavior and organization of soft materials, giving rise to macroscopically observable effects, such as phase transitions not seen with spherical particles and pattern formation in out-of-equilibrium active and living systems. Understanding how this happens is fundamentally challenging, yet worth the effort, as it will help us control and engineer material properties and desired behaviors. My research focuses on harnessing fundamental knowledge in soft matter to enable the development of new materials and understand aspects of biological processes. In the first part of the talk, I will review my work on the self-assembly and phase behavior of disk-shaped particles, including the emergence of ordered liquid crystal phases and re-entrant phase transitions. I will discuss the role of particle shape and interaction anisotropy, and demonstrate how one can utilize tunable particle interactions to control colloid self-assembly and stabilize interfaces. In the second part of the talk, I will present my findings on hydrogel shape transitions induced by anisotropic deswelling and imposed geometric (toroidal) constraints. I will discuss a new 3D printing technique developed during my post-doctoral work that enables easy fabrication of hydrogels of any desired shape, and demonstrate how toroidal hydrogel substrates are ideal to address the role of curvature and confinement on system-level regulation of cell proliferation.

Bio:

Ya-Wen Chang received her B.S. degree in Chemical Engineering from National Taiwan University in 2006. She completed her Ph.D. in 2012 under the supervision of Prof. Zhengdong Cheng in the Department of Chemical Engineering at Texas A&M University. She is currently a postdoctoral fellow in the Soft Condensed Matter Laboratory led by Prof. Alberto Fernandez-Nieves in the School of Physics at Georgia Institute of Technology. Her research involves understanding the behavior of soft materials, including the controlled assembly and dynamics of colloids, surfactants, polymers, and living cells; and build on the developed knowledge to engineer reconfigurable materials. She has developed technologies to fabricate 3D soft objects and biological constructs for the engineering and study of multicellular aggregates. She was also involved in the development of amphiphilic nanosheets for surfactant applications.