THE MATERIALS SCIENCE AND ENGINEERING DEPARTMENT SPRING COLLOQUIUM SERIES PRESENTS:

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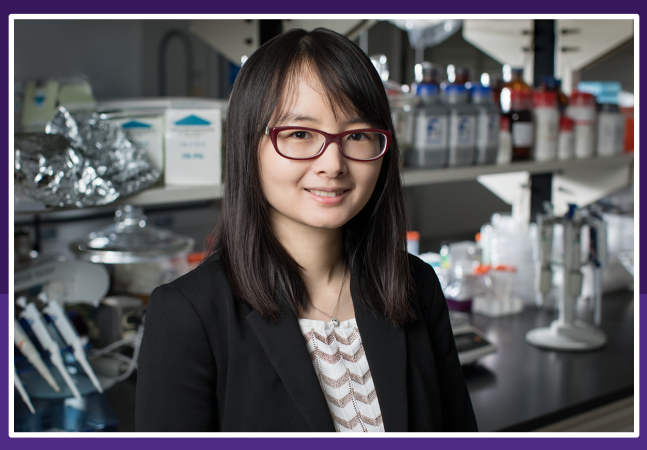

“Cinematography” of soft materials (nanoparticles, proteins, and polymer membranes) at the nanoscale

I will discuss my group’s recent progress on applying low-dose liquid-phase transmission electron microscopy (TEM) to synthetic and biological systems. In the first system, we focus on the phase behaviors of nano-sized building units as they are dispersed in solution. As a proof-of-concept, we directly image the otherwise elusive crystallization pathways of nanosized colloids into superlattices, where the discreteness and multi-scale coupling effects complicate the free energy landscape and the application forms of the final superlattices. We find that there exist similarities to the prevalent model system of micron-sized colloids, such as a non-classical two-step crystallization pathway, and an agreement with the capillary wave theory. But there are also differences, in particular, a universal layer-by-layer growth mode that we observe consistently for diverse nanoparticle shapes. Single particle tracking, trajectory analysis, and simulations combined unravel the energetic and kinetic features rendering this crystal growth mode possible and universal at the unexplored nanoscale, enabling advanced crystal engineering. In the second system, we sandwich and capture moving membrane proteins in their native lipid and liquid environment at nm resolution. The proteins exhibit real-time “fingering” fluctuations, which we attribute to dynamic rearrangement of lipid molecules wrapping the proteins. The conformational coordinates of protein transformation obtained from the real-space movies are used as inputs in our molecular dynamics simulations, to verify the driving force underpinning the function-relevant fluctuation dynamics. This platform invites an emergent theme of structural biophysics as we foresee. In the third system, we further push direct imaging to separation membranes and multivalent ion batteries, on the synthetic morphogenesis and strain engineering.

Prof. Qian Chen is currently an Assistant Professor in the Materials Science and Engineering Department at University of Illinois at Urbana-Champaign (UIUC). She obtained her PhD from the same department with Prof. Steve Granick (2012) and did her postdoc with Prof. Paul Alivisatos at UC Berkeley under Miller Fellowship. She joined the faculty of UIUC in 2015 and since then has received awards for the research in her group including Victor LaMer award in ACS (2015), Forbes 30 under 30 Science List (2016), Air Force Office of Scientific Research YIP award (2017), National Science Foundation CAREER award (2018), Sloan Research Fellow in Chemistry (2018), Unilever award in ACS (2018), and Dean’s Award for Excellence in Research (2020). The research in her group focuses on the broad scheme of imaging, understanding and engineering soft materials at the nanoscale, including systems such as colloidal self-assembly, protein aggregation, advanced battery devices, and energy-efficient separation strategies.

Tuesday, April 28 • 4 pm | Tech M361

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