THE MATERIALS SCIENCE AND ENGINEERING DEPARTMENT
WINTER COLLOQUIUM SERIES PRESENTS:

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"Cinematography" of soft, biological and energy matter at the nanoscale

I will discuss my group's recent progress on adapting a suite of electron microscopy methods (e.g., liquid-phase TEM, electron tomography, scanning electron nanodiffraction (SEND)) and machine-learning based data-mining to synthetic soft, biological and energy related 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 crystallization pathways of nanosized colloids into superlattices, where the discreteness and multi-scale coupling effects complicate the free energy landscape. We find that there exist similarities to the prevalent model system of micron-sized colloids, such as a non-classical 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 for diverse nanoparticle shapes. Single particle tracking and simulations combined unravel the energetic and kinetic features associated with this crystal growth mode, enabling advanced crystal engineering. In the second system, we study membrane proteins in their native lipid and liquid environment at the nanometer 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, where the strain embedded heterogeneously within leads to morphogenesis and distinct charge transport properties. We achieve concurrent imaging of chemical phases and strains at an unprecedented nanometer resolution by SEND, which elucidates an intriguing chemomechanical coupling with nanoscale heterogeneity encoded by solvent and charge rate of the battery systems. We foresee our suite of "cinematography" tools to provide crucial and complementary insights in various materials systems, with the common theme of probing the elusive nanoscale.

Prof. Chen received her BS in Chemistry from Peking University (2007), and her PhD in Materials Science and Engineering from UIUC with Prof. Steve Granick (2012). She then won the prestigious Miller fellowship and worked with Prof. A. Paul Alivisatos at UC Berkeley. She joined MatSE at UIUC as an assistant professor since 2015.

Tuesday, February 2 • 4 pm CT • Zoom

Registration is required. RSVP link.

Questions? Contact Kristina.lugo@northwestern.edu.

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