DEPARTMENT OF CHEMICAL AND BIOMOLECULAR ENGINEERING

UNIVERSITY OF DELAWARE
ENGINEERING

2023 SEMINAR SERIES

Attend virtually: https://udel.zoom.us/j/91386404306

KURT WOHL
MEMORIAL LECTURE

COLLOIDAL GELS FROM PLASMONIC METAL OXIDE NANOCRYSTALS

SEP 15 | 10:00 AM | 102 COLBURN LAB

DELIA MILLIRON

UNIVERSITY OF TEXAS AT AUSTIN

Ernest Cockrell, Jr. Memorial Chair and Department Chair

Controlling the arrangement of inorganic nanocrystals in assemblies allows realization of materials whose properties depend both on the distinctive characteristics of their nanoscale building blocks and on their organization. We assemble gel networks from colloidal nanocrystals that absorb infrared light due to their composition-tunable plasmonic resonance. Nanocrystal gels are interesting because their porous, percolating structures can in principle lead to structure-tunable material properties with dynamic reconfigurability. However, determining structure and measuring interactions is less straightforward for soft, disordered materials like colloidal gels, motivating the development of experimental systems that minimize complexities, except those deliberately introduced to analyze their effects, and of systems designed to make quantitative measurements of structure and thermodynamics possible. Inorganic nanocrystals offer a versatile platform for fundamental studies of colloidal assembly, being high uniform in size and morphology and having customizable surface functionality, where capping ligands can be exchanged to direct their interactions. For instance, oleate-capped indium oxide nanocrystals were analyzed by small angle X-ray scattering and shown to interact as hard spheres, making them an ideal colloidal system for controlled introduction of attractions—by depletion or chemical linking—to induce assembly. Further, by using colorimetric metal coordination links to assemble nanocrystals into networks, we enable thermodynamic analysis of the linking chemistry to establish the structural basis for thermoreversible gelation in plasmonic doped indium oxide nanocrystal networks. Plasmon coupling upon assembly causes a large shift in the infrared optical absorption, so these gels are thermally switchable optical materials. Their optical spectra also contain hints about the gel structure that we unravel by using large-scale simulations based on many-bodied coupling between their induced dipoles. The development of such near-ideal experimental systems presents opportunities to validate theoretical frameworks and to experimentally realize materials that are computationally designed or optimized for a specific optical response.

ABOUT THE SPEAKER

Delia J. Milliron is the Ernest Cockrell, Jr. Memorial Chair and Department Chair of Chemical Engineering at the University of Texas at Austin. Dr. Milliron received her AB from Princeton University and her PhD from the University of California, Berkeley. She initially worked for IBM's research division, then joined the research staff at the Molecular Foundry, Lawrence Berkeley National Lab. At UT Austin Dr. Milliron develops nanocrystal-based materials in which abundant interfacial area and confined volume produce drastically different properties than those of homogeneous bulk materials. Such unconventional properties offer new opportunities for optoelectronics and clean energy technologies. Dr. Milliron has been recognized with awards including the DOE Early Career Research Program, the ACS Inorganic Nanoscience Award, Senior Membership in the National Academy of Inventors, the Hackerman Award from the Welch Foundation, and the O'Donnell Award in Engineering from the Texas Academy of Medicine, Engineering, Science & Technology.