Colloquium

Multi-Component Nanoscale Assembly for Nanocrystal-Based Materials and Devices | Colloidal Semiconductor Quantum Dot Optoelectronics

Christopher B. Murray & Cherie R. Kagan
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Host: Maria Ibanez

Christopher B. Murray |Multi-Component Nanoscale Assembly for Nanocrystal-Based Materials and Devices"The advances in the multiscale multi-component organization of ensembles of monodisperse colloidal nanocrystals (NCs) with controlled composition, size, and shape now represent a new strategy for soft optical metamaterial fabrication. These NCs, acting as 'artificial atoms' with tunable electronic, optical, and magnetic properties, pave the way for the development of a new periodic assembly. They are ideal building blocks for incorporation into new thin films, micro-resonators, and integrated devices. In this brief talk, I will briefly outline how these tailored NCs can be assembled into single-component, binary, and ternary NC superlattices, providing a scalable route to the production of soft metamaterials. The scalability of this process ensures its feasibility for large-scale applications. The modular assembly of these NCs enables the enhancement of desirable features of the underlying quantum phenomena through photonic feedback. Strategies for emulsion-based assembly that enable continuous production and tuning of stimuli-responsive, tunable photonic resonators from dense NC 'supraparticles' will be highlighted. Progress in the optical characterization of supraparticles and their potential as whispering-gallery-mode resonators, with a low lasing threshold, will be shared.____________Cherie R. Kagan |Colloidal Semiconductor Quantum Dot OptoelectronicsColloidal semiconductor quantum dots (QDs) are prized for their size-dependent electronic and optical properties, with bandgaps tunable from the UV to the infrared, and as solution-processable building blocks of “artificial” solid-state materials. Here, I will describe our work in designing the electronic and optical properties of QD assemblies and their integration in optoelectronic devices. We use chemical treatments, namely ligand exchange, colloidal atomic layer deposition, and cation exchange to tailor interparticle distance and composition, to add impurities, control stoichiometry, or make entirely new compounds or matrices. Electrical and cw, ultrafast, and spatially resolved optical spectroscopies are used to show that these treatments allow the design of QD assemblies with tailored carrier energy, type, concentration, mobility, and lifetime, which we have used to create n- and p-type thin films from which we build optoelectronic and electronic devices and circuits.

Thursday, February 19, 2026 11:30am - 12:30pm

Raiffeisen Lecture Hall

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