Combinatorial screening of colloidal nanoparticles for high throughput materials development

Dr. Emory Chan
Inorganic Nanostructures Facility
The Molecular Foundry
Lawrence Berkeley National Laboratory
Berkeley, CA 94720

Robust and controllable methods for synthesizing colloidal nanoparticles are essential for nanoscale applications in energy conversion, catalysis, and biology, which often require critical materials. Traditional nanocrystal syntheses, however, are difficult to optimize due to numerous experimental parameters that are difficult to control. We describe the use of an automated nanocrystal synthesis platform for the high-throughput screening and combinatorial optimization of semiconductor, oxide, metal, doped, and heterostructured inorganic nanocrystals. We demonstrate precise control over the high temperature synthesis of semiconductor quantum dots, enabling systematic investigations into the kinetics of nanocrystal nucleation and growth. We also demonstrate the combinatorial optimization of lanthanide-doped nanocrystals, which can be used in magnetic applications and for the low-autofluorescence imaging of biological samples. Theoretical models validated by high-throughput experiments were used to elucidate the critical energy transfer mechanisms that give rise to spectrally pure upconverted emission valuable for multiplexed biological assays.