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Interrogations of semiconductor quantum dots via ultrafast spectroscopy and hydrostatic pressure

Quantum-confined semiconductor nanocrystals (NCs) offer numerous desirable properties for applications in areas such as bio-labeling, lasing, energy generation, and utilization. Chief among these assets are size-tunable bandgaps, synthetic scalability, and low-cost solution processing. However, the quantum-confined aspect of NCs imparts a discrete electronic density of states that profoundly impacts the physical properties of these materials in comparison to the bulk-phase compositions. Moreover, the high ratio of surface to interior atoms within these few nanometer diameter particles makes interfacial phenomena highly relevant to observed properties such as photoluminescence quantum yield. In this talk, I will present analytical efforts aimed at understanding the electronic properties of this material class using transient and static optical spectroscopies paired with hydrostatic pressure imparted via a diamond anvil cell. Using these techniques, we have been able to interrogate the roles of surface vs core-derived photoluminescence in nanomaterials, as well as understand the physics of multiexcitons within the unique scenario of NC materials.

Biography

Richard D. Schaller obtained his Ph.D at the age of 27 from the University of California at Berkeley in 2002 and performed postdoctoral studies at Los Alamos National Laboratory where he was also a technical staff member for four years. He is now a scientist within Argonne National Laboratory's Center for Nanoscale Materials and is also an assistant professor at Northwestern University in the Department of Chemistry. He has published 59 papers that together have been cited more than 3900 times, and holds three patents.

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