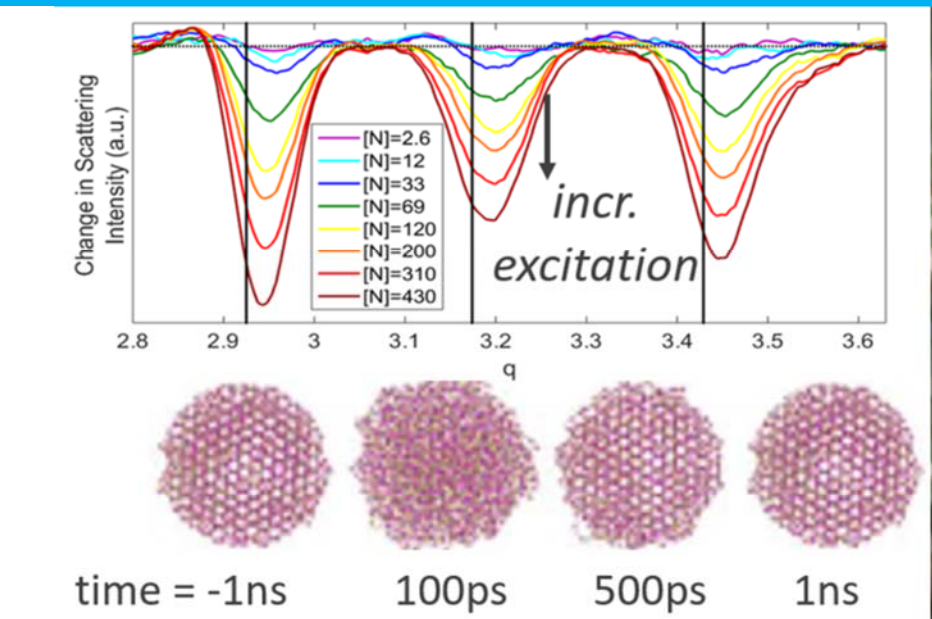
PHYSICAL SEMINAR

Title: "Transient Lattice Dynamics of Technologically Relevant Semiconductor Nanomaterials"



Guest Speaker:

Professor Richard D. Schaller

Northwestern University

Department of Chemistry

Monday, October 28

4:00 PM

473 Hutchison Hall

Department of Chemistry

Abstract: Colloidally prepared, quantum-confined, semiconductor nanocrystals offer tunable energy gaps, strong photoluminescence, and, in some cases desirable properties such as optical gain and lasing. The role of thermal energy deposition in these nanoscopic structures has not been substantively probed. We have been performing ultrafast optical pump, X-ray diffraction probe experiments at Argonne National Lab's Advanced Photon Source on semiconductor nanocrystal (NC) colloidal dispersions as functions of particle size, polytype, and pump intensity to examine lattice response. Shifts of diffraction peaks relate lattice heating and peak amplitude reduction conveys transient lattice disordering (or melting). Intraband and Auger-derived heating is clearly observed for low fluences, and disordering was observed upon absorption of larger numbers of photons excitations per NC on average. Diffraction intensity recovery kinetics, attributable to recrystallization, occur over hundreds of picoseconds with slower recoveries for larger particles. NCs studied revert to initial structures following intense photoexcitation. These findings suggest a need to take into account nanomaterial physical stability and transient electronic structure for high intensity excitation applications such as lasing and solid-state lighting. Additional, emerging experimental routes to probing and controlling thermal energy in material systems will also be presented.

Host: Professor Katie Knowles , email: kknowles@ur.rochester.edu