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Electron - acoustic phonon coupling in colloidal lead sulfide quantum dots BYUNGMOON CHO, VIVEK TIWARI, AUSTIN SPENCER, DMITRY BARANOV, SAMUEL PARK, DAVID JONAS, Univ of Colorado - Boulder — Lead chalcogenide quantum dots (QDs) with bandgaps in the shortwave infrared are candidate materials for next generation photovoltaics exceeding the Shockley-Queisser limit. Despite ongoing controversy, multiple exciton generation (MEG) in QDs offers potential for improved photovoltaic efficiency. Hot carriers from high energy photoexcitation dissipate excess energy via coupled phonons; this is detrimental to MEG. The electron-phonon coupling (EPC) magnitude, partitioning among modes and dependence on the size/shape are poorly understood. We performed degenerate femtosecond pump-probe spectroscopy to investigate Auger recombination dynamics, a reverse process of MEG. We observe a quantum beat due to coherent acoustic phonons in femtosecond pump-probe signals from oleate capped colloidal lead sulfide QDs in toluene. A 3.4 ps period oscillation decays with 4.6 ps damping constant in 8 nm diameter dots; the amplitude increases linearly with pump energy and modulation is weaker than reported in smaller dots. An elastic continuum model for acoustic phonon frequency vs. dot diameter suggests a not yet understood quantitative discrepancy with prior work. These relaxation processes have important implications for QD photovoltaics.

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