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Low threshold amplified spontaneous emission and Auger recombination suppression in giant nanocrystal quantum dots ISTVAN ROBEL, FLORENCIO GARCIA-SANTAMARIA, RICHARD D. SCHALLER, YONGFEN CHEN, JENNIFER A. HOLLINGSWORTH, VICTOR I. KLIMOV, Chemistry Division, Los Alamos National Laboratory, Los Alamos, NM 87545, USA — Nanocrystals quantum dots (NQDs) are attractive materials for various light-emitting applications including optical amplification and lasing. A complication associated with the multiexcitonic nature of light amplification is NQDs is the picosecond optical-gain decay induced by nonradiative Auger recombination, in which one exciton recombines by transferring the energy to the other. Here, we present new results on a novel type of nanocrystals dubbed "giant" quantum dots (g-NQDs). These g-NQDs comprise an emitting core particle of CdSe overcoated with a thick shell (up to 20 monolayers) of wider-gap CdS. We report that biexciton and gain lifetimes are greatly augmented and the ASE threshold drops down to just a few μJ/cm2. We explain this result by a significant increase in the absorption cross-section of g-NQDs compared to traditional nanocrystals and lengthening of biexciton lifetimes. We also observe other unusual optical-gain behaviors for these structures such as multi-band ASE, the spectra spectral range of optical amplification extends over more than 500 meV. These results demonstrate that g-NQDs are very promising materials for applications in practical lasing technologies.

Florencio Garcia-Santamaria
Chemistry Division, Los Alamos National Laboratory,
Los Alamos, NM 87545, USA

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