

Electron-phonon coupling and single-exciton optical gain in semiconductor nanocrystals

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Optical gain in an ensemble of semiconductor nanocrystals is usually difficult to reach because multi-excitons efficiently decay by non-radiative Auger process. Therefore we examine theoretically the conditions required to obtain optical gain in the single-exciton regime, which is very attractive for low-threshold laser applications. We show that the electron-phonon interaction can play a very positive role, in addition to the exciton-exciton interaction. In that situation, the optical gain regime can be reached even when the population of nanocrystals containing single excitons is below 10%. On the basis of these results, we propose that ultra-small nanocrystals, or nanocrystals with deep defects at their surface, could be promising materials for light amplification.¹

1. P. Geiregat, G. Allan, Z. Hens, C. Delerue, Phys. Rev. B 93, 115416, 2016