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Plasmon-Enhanced Silicon Nanocrystal Photoluminescence JULIE BITEEN, NATHAN LEWIS, HARRY ATWATER, California Institute of Technology — We report two approaches to increase the luminescence emission intensity from Si nanocrystals (nc-Si) under optical pumping via: 1.the use of nanoporous Au (npg) as a sensitizer for nc-Si emission, and 2.near-field coupling of nc-Si emission to localized surface plasmons on npg surfaces to increase the radiative emission rate relative to conventional nc-Si emission. When nc-Si emitting at 1.7eV is coupled to npg, we have observed an order of magnitude enhancement in photoluminescence intensity while the emission energy remains unchanged. This enhancement is concurrent with a two-fold increase in the average radiative rate (which leads to faster decay rates and decreased saturation effects with increased pump powers) and a more than two-fold enhancement in the effective absorption cross section. We find the greatest enhancements when the nc-Si is 10 nm from a 100-nm thick npg film with surface roughness and voids on the order of 10 nm, and we will present a systematic study of the dependence of enhanced pump absorption cross-section and enhanced radiative emission as a function of npg-Si separation. We interpret our results as a consequence of a trade off between enhanced emission mediated by Förster (dipole-dipole) energy transfer processes and quenching in carrier tunneling processes, each of which has a unique distance dependence.

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