Abstract Submitted
for the MAR09 Meeting of
The American Physical Society

Decay-rate distribution of single quantum dots in nanometer-scale proximity to a metal film MATTHEW PELTON, XIAOHUA WU, Argonne National Laboratory — Recently, the interaction between fluoresecent colloidal semiconductor quantum dots and plasmonic metal nanostructures has attracted great interest, both for the development of a basic understanding of nanoscale photophysics and for potential applications in improved light-emitting devices and integrated plasmonic circuits. Time-resolved measurements on single dots are required in order to overcome the obscuring effects of ensemble averaging and of time averaging, and thus reveal the physical mechanisms of dot-metal interaction. In this work, we present measurements of photoluminescence decay dynamics from single colloidal CdSe/ZnS core-shell quantum dots in nanometer-scale proximity to a smooth gold film. We extract the decay rate, k_m, for each dot when it is in its maximum-intensity state, thereby removing the effects of nonradiative decay-rate fluctuations. We find that, as the separation between the dot and the metal decreases, the k_m distribution becomes broader and its maximum increases. The increase in maximum decay rate is caused by stronger energy tranfer from the quantum dot to the metal film, as expected. The broader distribution of decay rate, on the other hand, reflects inherent variations in the interactions between individual dots and the metal film.

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Date submitted: 11 Mar 2009 Electronic form version 1.4