Enhanced emission and accelerated nanoscale energy transportation between quantum dots using Au nanoparticles' surface plasmons

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In the first half of the presentation, we will present the resonant and off-resonant interaction between the quantum dot (QD) excitons and surface plasmon (SP) dipole fields from metal anostructures, for enhancing the light emission process from QDs. Surface plasmon enhanced photoluminescence (PL) from CdTe QDs on monolayers of Au nanoparticles (Au NPs) is investigated under both resonant and nonresonant conditions. Enhancement of the QDs PL intensity is observed when the emission spectrum is red shifted with respect to the SP absorption resonance. Coupling to the SPs results in a red shift and broadening of the PL spectrum, and an increase in the PL decay rate. The largest coupling is observed for QD monolayers with peak emission at 667 nm, producing a ten fold increase in PL intensity [1]. No change in PL intensity and decay rate is observed at the SP resonance.

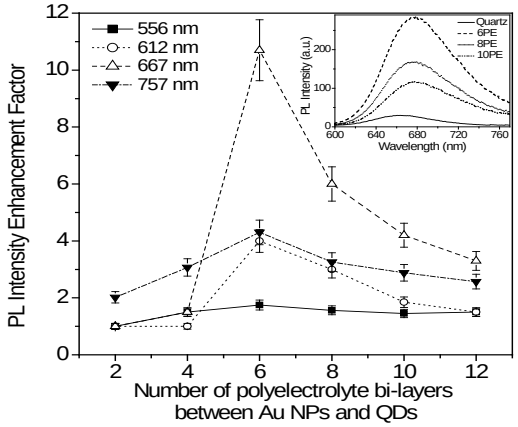

Figure: *Dependence of the PL intensity enhancement factor on the number of polyelectrolyte bi-layers between CdTe QDs and Au NPs. Inset: PL spectra for 2 monolayers of QDs on quartz (peak emission at ~ 667 nm) and on the Au NP layer with spacers of 6, 8 and 10 PE bi-layers.*

In the second part, we will present the accelerated Förster resonance energy transfer (FRET) between QDs in proximity to SP dipole fields. FRET between QDs at nanoscale proximity to Au NP layers is investigated experimentally [2,3]. We have observed the enhancement in the acceptor QDs' PL lifetime intensities. The decrease in donor QDs' exciton lifetime from 5.74 to 2.06 ns, accompanied by an increase in acceptor QDs' exciton lifetime from 3.38 to 7.52 ns, provided evidence for enhanced FRET between the QDs near Au NPs. The Au NPs' SP dipole fields are assisted to overcome the weak electronic coupling between the emitting (donor) and absorbing (acceptor) transition exciton dipoles in the homogeneous medium.

(1) Komarala V. K et al,; Applied Physics Letters 89 (2006) 253118.
(2) Komarala V. K et al.; Applied Physics Letters 93 (2008) 123102.
(3) Komarala V.K. et al,; Proceedings-SPIE The International Society for Optical Engineering, 6641 (2007) 66410Y