Quantum Plasmonics and Plexcitonics

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A recently developed fully quantum mechanical approach for the description of plasmonic and excitonic nanoparticles and their interactions is presented. Quantum effects can have a pronounced influence on the electric field enhancements near the nanoparticle surfaces and on the optical properties strongly coupled nanoparticles.[1] For closely spaced metallic nanoparticles, electron transfer and nonlocal screening can drastically reduce the electric field enhancements across the gap and result in a Charge Transfer Plasmon (CTP) where an oscillatory electric tunneling current flows between the particles,[2] and strongly nonlinear effects can be induced.[3] The energy of the CTP is found to depend strongly on the electronic structure of the junction and the presence of molecules inside the gap.[2,4] For the coupled plasmonic-excitonic system where hybrid plexciton states are formed,[5] quantum effects can strongly modify the optical spectrum and induce highly nonlinear response.

  L.S. Slaughter et al., ACS Nano 4(2010)4657