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Exciton-plasmon interaction and photo-injection of plasmonic hot carriers in hybrid nanostructures ALEXANDER GOVOROV, HUI ZHANG, Ohio University, MIN OUYANG, University of Maryland, College Park, YURII GUN'KO, School of Chemistry, University of Dublin, Trinity College — We investigate theoretically the effects of exciton-plasmon interaction and plasmon-assisted carrier injection in a hybrid semiconductor-metal nanostructure under resonant optical excitation. We treat the coupling between the metal and semiconductor nanocrystals using a many-body Fano model and a quantum density-matrix formalism. Hot carriers have a characteristic energy distribution in the plasmon wave function in a metal nanocrystal and participate in tunnel and ballistic injection currents to the neighboring semiconductor nanostructure. The photo-current induced by hot plasmonic electrons in the nanostructure depends on the barrier height, excitation frequency, plasmon energy, relaxation rates, and geometry of a device. The Coulomb exciton-plasmon interaction may also play an essential role in the optical absorption and electron injection. The results obtained in this study can be used to design and describe a variety of plasmonic nanodevices with hot electron injection for photo-catalysis, light-harvesting, and solar cells.

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