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Photogeneration of hot plasmonic carriers with metal nanocrystals ALEXANDER GOVOROV, HUI ZHANG, Ohio University, YURII GUN'KO, Trinity College, Dublin — We investigate the effect of plasmon-assisted carrier injection from metal nanocrystals to a semiconductor contact or to adsorbed molecules. We treat the problem of optically-driven metal nanocrystal using the quantum approach of equation of motion of density matrix. Energy distributions of optically-excited plasmonic carriers are very different in metal nanocrystals with large and small sizes. In large nanocrystals, most excited carriers have very small energies and the electron distribution resembles the case of a plasmon wave in bulk. For gold nanocrystal with smaller sizes (less than 20nm), the energy distribution of hot carriers becomes flat and has a large number of carriers with high energy. Therefore, smaller nanocrystals are preferable for injection of plasmonic carriers into semiconductors or into molecules on the surface. The physical reason for the above behavior is non-conservation of momentum in a nanocrystal. The geometry, type of metal, and orientation of the external electric field are important to obtain high quantum efficiencies of generation and injection of plasmonic electrons. The results obtained in this study can be used to design a variety of plasmonic nano-devices based on hot electron injection for photocatalysis, light-harvesting, and solar cells.

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