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Surface plasmon decay dynamics in nanostructured systems: A Feynman diagram approach[1] PRINEHA NARANG, RAVISHANKAR SUNDARARAMAN, ADAM S. JERMYN, WILLIAM A. GODDARD III, HARRY A. ATWATER, California Institute of Technology (Caltech) — The decay of surface plasmon resonances is usually a detriment in the field of plasmonics, but the possibility to capture the energy normally lost to heat would open new opportunities in photon sensors and energy conversion devices. In the context of hot-electron devices, the large extinction cross-section at a surface plasmon resonance enables nanostructures to absorb a significant fraction of the solar spectrum in very thin films. Despite the significant experimental work in this direction, a complete theoretical understanding of plasmon-driven hot carrier generation with electronic structure details has been evasive. Recently we analyzed the quantum decay of surface plasmon polaritons and found that the prompt distribution of generated carriers is extremely sensitive to the energy band structure of the plasmonic material. In this context, we use a Feynman diagram approach to describe processes involving plasmons, electrons and phonons in plasmonic hot carrier generation. Built upon this general theoretical and computational framework, we present results on higher order processes such as multi-plasmon decays in metals which are critical for plasmon-driven upconversion.

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