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Relaxation Dynamics of Quantum Emitters Resonantly Coupled to a Localized Surface Plasmon

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Abstract : We investigate relaxation dynamics of a quantum dipole emitter (QDE), e.g., a molecule or quantum dot, located near a metal nanoparticle (MNP) exhibiting a dipolar localized surface plasmon (LSP) resonance at the frequency of the QDE radiative transition. It is shown that under the condition of the QDE-MNP characteristic relaxation time being much shorter than that of the QDE in free-space but much longer than the LSP lifetime. It is also shown that energy dissipation in the QDE-MNP system is relatively weak with the probability of the photon emission being about 0.75, a number which, rather surprisingly, does not explicitly depend on the metal absorption characteristics. The degree of entanglement measured by the concurrency takes the maximum value, while the distances between the QDEs and metal ball approximately are equal.

Keywords : metal nanoparticle, localized surface plasmon, quantum dipole emitter, relaxation dynamics
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