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Plasmon-exciton coupling in bilayer plexiton nanoparticles

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Abstract
In this article, the excitation of optical states arising from plasmon-exciton coupling in bilayer nanoparticle structures is simulated and analyzed using the finite-difference time-domain method. Optical properties and Rabi splitting are examined through the extinction cross-section analysis of the nanoparticles. Given the sensitivity of the excitation energies of plasmonic and excitonic modes to structural parameters, such as nanoparticle size, this characteristic can be leveraged as a precise tool to tune the coupling strength and Rabi splitting between primary modes, enabling the creation of optimized new hybrid states. Due to the unique properties of gold and silver in supporting localized surface plasmons and the high oscillator strength of cyanine molecules in excitonic excitations, the coupling of these materials is evaluated. Results show that coupling gold and silver with cyanine can yield new plexcitonic states within the strong coupling regime. The emergence of multiple plexcitonic modes in the optical spectra holds broad potential applications in photonic sensors, optical switches, and quantum information processing.

Keywords: plasmon, exciton, Rabi splitting, plexciton

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