Polarization Engineering photon entanglement between orthogonal quantum-dot exciton states coupled to whispering-gallery modes

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Abstract:

We demonstrate that in a whispering-gallery modes, excitations of confinement surface plasmon modes can be used to engineer anisotropy-induced photon entanglement between orthogonal quantum-dot exciton states. Our electromagnetic modes calculations rely on Green's function techniques, providing exact solutions for all modes. Strong confinement of light in such a device, driven spin-orbit interactions at the nanoscale, allows to break symmetry and selectively favor one direction by engineering the dipole spin with a single or multi-emitters. The spectral density of states is immensely enhanced in the vicinity of the whispering-gallery modes, mediating a strong coupling regime and effective quantum interference where the excitation energy can coherently be transferred between the orthogonal quantum-dot exciton states and the subwavelength confinement of optical fields in the whispering-gallery modes, causing the long-lived entangled exciton states. This structure offers excellent noise suppression and enables high accurate particle size information extraction, presenting an intriguing approach for fine-tuning the practical experimental parameters to achieve robust photon-emitters coupling for promising applications in topological photonic circuits.