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Spotlight on "Hybrid metal-dielectric nanocavity for enhanced light-matter interactions"

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Spotlight summary:

Hybrid metal-dielectric nanocavities: in medio stat virtus

Strong confinement of the light in a very small volume is the key towards efficient broadband cavity quantum electrodynamics (CQED) systems. Scientists are rushing to push light confinement to the limit, deeply in the sub-wavelength regime, playing on either the geometry or the material of optical cavities. Dielectric and metallic cavities have been proved to be both viable approaches, but… what if we try to go right in the middle?

This is actually where Y. A. Kelaita and coworkers have gone in their research. In this work, they have demonstrated that a hybrid metal-dielectric nanocavity can provide more than one order of magnitude reduction in mode volume compared to state of the art photonic crystal CQED systems. The proposed cavity consists of a dielectric cylindrical nano-pillar, realized on a conventional InAs/GaAs quantum photonics platform, which is laterally coated with silver. InAs quantum dots provide large internal quantum efficiency and short radiative lifetime; the metallic confinement leads to strong and broadband spontaneous emission rate. The fabrication of such a nanocavity is challenging because a conformal metal coating is required to sustain efficiently the cavity mode.

To this aim a novel metal evaporation technique has been developed that leaves the top of the cavity free of metal, enabling surface-emission and good collection efficiency.

Strong enhancement of broadband spontaneous emission is demonstrated at 10 K, but the authors believe that the proposed platform can be easily extended to emerging room-temperature quantum systems. They also think that their fabrication strategy would enable the realization of more sophisticated structures with even smaller mode volumes.

Nanocavities go hybrid, quantum electrodynamics goes better.

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