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Hybrid metal-dielectric nanocavity for ultrafast quantum dot optical field interaction[1] KEVIN FISCHER[2], THOMAS BABINEC, YOUSIF KELAITA, KONSTANTINOS LAGOUDAKIS, TOMAS SARMIENTO, ARMAND RUNDQUIST, Stanford University, ARKA MAJUMDAR, University of Washington, JELENA VUCKOVIC, Stanford University — Efficient light-matter interfaces for solid-state quantum emitters offering high single-photon collection efficiency as well as strong light-matter interaction are an important ingredient to a variety of quantum technologies. In this talk we introduce and demonstrate a new light-matter interface based on a hybrid metal-dielectric nanopillar cavity coupled to a single InAs quantum dot (QD). Its essential design characteristics include low quality factor Q $\approx$ 25 resonance, ultrasmall mode volume V $\approx$ 0.04 $(\lambda/n)^3$, and record-high coherent coupling g/2π $\approx$ 150-200GHz, exceeding those offered in other light-matter interfaces including in photonic crystal cavities coupled to single QDs. We have observed that the single QD emitters are both embedded in the nanometallic devices and well-coupled to the orthogonal nanocavity modes, that our devices significantly enhance the spontaneous emission rate of the QD transitions (Purcell factor Fp $\approx$ 8 relative to bulk), and that overall single photon flux from the QD is increased by nearly two orders of magnitude relative to bulk. We conclude with an outlook for applications of this nanocavity geometry in information processing.

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