Diamond Nanophotonics and Quantum Optics

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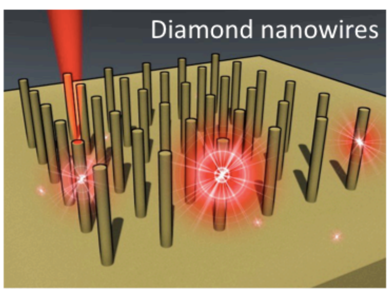
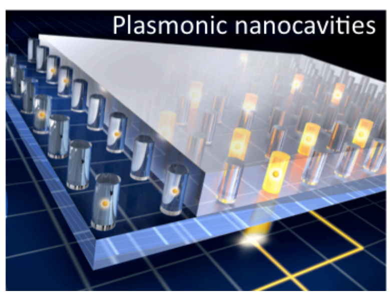
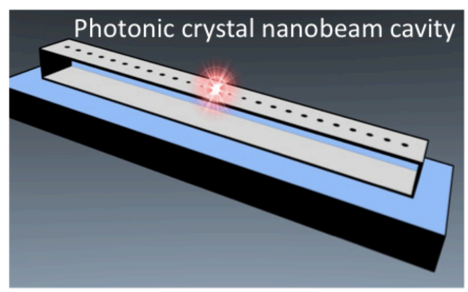
Individual color centers in diamond have recently emerged as a promising solid-state platform for quantum communication and quantum information processing systems, as well as sensitive nanoscale magnetometry with optical read-out. Performance of these systems can be significantly improved by engineering optical properties of color centers using nanophotonic approaches. In this work we describe a high-flux, room temperature, source of single photons based on an individual Nitrogen-Vacancy (NV) center embedded in a top-down nanofabricated, single crystal diamond nanowires[1], plasmonic nano-apertures[2], and all-diamond based optical cavities[3,4]. Using the nanowire geometry, for example, an order of magnitude brighter single photon source is realized, compared to an NV center in a bulk diamond[1]. By embedding diamond nanowires in metals 10-fold enhancement of NV's spontaneous emission, due to large Purcell effect provided by metallic nanocavity, was demonstrated[2]. Finally, single-photon emission of NVs inside ring and photonic crystal resonator, fabricated directly in diamond, as well as single photon routing in an on-chip optical network has been achieved[4]. In addition to applications in quantum information processing, and owing to its excellent physical and chemical properties, diamond based optical nanostructures are of great interest for applications ranging from optoelectronics and NEMS/MEMS to life-sciences and sensing.







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