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Coupling Nitrogen Vacancy Centers in a Diamond Nanopillar to a Silica Microsphere KHODADAD DINYARI, MATS LARSSON, HAILIN WANG, Department of Physics, Oregon Center for Optics, University of Oregon, Eugene, Oregon 97403 — Nitrogen vacancy (NV) centers in a diamond nanopillar have been coupled to the whispering gallery modes (WGMs) of a silica microsphere. The NV centers were coupled to the WGMs by positioning a nanopillar near the equator of the microsphere with nanometer precision. For cavity QED studies, WGMs with $l = m$ are of interest due to their small mode volumes. It was observed that when a 200 nm diameter nanopillar was optimally coupled to this particular mode in a 50 μm diameter microsphere, the quality factor (Q) was only reduced to 2x10^6 from an initial Q of 6x10^6. The nanopillars were fabricated from a bulk single crystal diamond by means of reactive ion etching, resulting in nanopillars with diameters as small as 200 nm with a height of approximately 1 μm. We estimate that a 140 nm pillar would allow a cavity linewidth of order 20 MHz, comparable to the zero phonon linewidth of a NV center. Producing a nanopillar with a 140 nm diameter is well within our fabrication technique making this composite system a suitable candidate for strong-coupling cavity QED. This nanopillar-microsphere system circumvents the poor controllability of nanocrystal based microresonator systems and utilizes the exceptional properties of both NV centers in bulk crystals and the ultra-high Q of silica microspheres.

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