

MAR11-2010-001666

Abstract for an Invited Paper  
for the MAR11 Meeting of  
the American Physical Society

### **Coupling single electron spins in diamond to integrated optical structures**

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Diamond is an attractive material for some electronic and photonic applications because of its excellent chemical stability and high thermal conductivity and carrier mobility. Diamond appears to be an excellent material for quantum information processing and magnetic sensing applications as well, with many optically active paramagnetic centers. Of these, the most carefully studied to date has been the nitrogen-vacancy (NV) color center, since it is optically addressable and can exhibit electron spin coherence lifetimes exceeding 1 ms at room temperature. This long-lived coherence is usually attributed to the nuclear spin-zero environment of the diamond lattice, which can be further improved with isotopic purification. These capabilities have recently allowed for some remarkable demonstrations in this system such as controlled coupling between single electronic and nuclear spins. For quantum information technologies, NV centers that are mutually optically coupled could enable long-distance quantum communication through repeaters. However, given the low branching ratio of natural emission from NV centers in bulk diamond into the zero phonon line, coupling these centers to cavities with at least moderately large Purcell factors is a critically important step. In this talk I will describe our recent progress in realizing microcavities with low loss and small mode volume in two hybrid systems: silica microdisks coupled to diamond nanoparticles, and gallium phosphide microdisks coupled to single-crystal diamond. In both cases, we have demonstrated coupling between NV centers and whispering-gallery-type cavity modes. Finally, I will present our most recent progress toward fabricating waveguides and microcavities directly in diamond.