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Quantifying Nitrogen-Vacancy Center Density in Diamond using Magnetic Resonance[1] MORGAN HAMILTON, University of Mount Union, CAROLA PURSER[2], The Ohio State University, ISAAC RAMPERSAUD, ARFAAN RAMPERSAUD, Columbus Nanoworks, P. CHRIS HAMMEL[3], The Ohio State University — Biologists have recently begun to use nanodiamonds as bright, florescent biomarkers. Florescence originates in transitions between the atomic-like, electronic energy levels of nitrogen-vacancy (NV) defects, composed of a nitrogen substitution adjacent to a carbon lattice vacancy. Engineering brighter nanodiamonds generally requires higher concentrations of NV centers, but quantifying these concentrations via optical measurements alone is prone to complications from surface termination, other defect concentrations, nanodiamond size, etc. Here, we aim to quantify NV densities from the intensity of their zero-field magnetic resonance absorption, centered at 2.87 GHz. To this end, we designed and characterized a tunable microwave cavity. For given cavity dimensions, Mathematica code was developed to visualize the resonant modes and calculate their resonant frequencies. From this a magnetic resonance cavity could be designed, and it was demonstrated that the measured resonance frequency matches the theoretical value very well as a function of the cavity length. Coupling from a coaxial microwave line to the cavity was enabled using a loop antenna. By modifying the inductance of the loop, the quality factor of the cavity was enhanced by a factor of three. We thus demonstrated a tunable microwave cavity that can be made to resonate with NV spins. Future work will involve incorporating the cavity in a magnet to measure the microwave absorption amplitude.

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