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Optimization of NV-Diamond Material Properties for High Sensitivity Magnetometry JENNIFER SCHLOSS, MIT/Harvard, DIANA CRAIK, ANDREW GREENSPON, XINGYU ZHANG, ERIK BAUCH, CONNOR HART, MATTHEW TURNER, Harvard, PATRICK SCHEIDEGGER, Harvard/ETH Zurich, EVELYN HU, RONALD WALSWORTH, Harvard — Enhancing the sensitivity of ensemble-based magnetometry using NV-diamond requires optimized diamond samples with a high density of negatively-charged NV centers, good fluorescence contrast, and long spin coherence times. Here we report a systematic study of both the conversion efficiency from nitrogen to NV- and the negative-to-neutral NV charge state ratio versus initial nitrogen concentration, irradiation dose, and optical excitation intensity. We present a theoretical model that describes the measured NV charge state dynamics in the presence of both green laser excitation and substitutional nitrogen defects. We correlate a range of characterization measurements, and we draw conclusions on the optimal samples for NV magnetometry, with applications to magnetic surveying, geophysics, and neuroscience.

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