Abstract Submitted
for the MAR14 Meeting of
The American Physical Society

Toward Deterministic Implantation of Nitrogen Vacancy Centers in Bulk Diamond Crystals[1] T.O. BRUNDAGE, Z. ATKINS, S. SANGTAWESIN, J.R. PETTA, Department of Physics, Princeton University — Over the last decade, research investigating the room temperature stability, coherence, and optical manipulation of spin states of the nitrogen vacancy (NV) center in diamond has made it a strong candidate for applications in magnetometry and quantum information processing. As research progresses and we begin to investigate the dynamics and scalability of multiple NV systems, the ability to place NV centers deterministically in the host material with high accuracy is critical. Here we implement a simple fabrication method for NV implantation. We expose and develop small dots in PMMA using an electron-beam lithography tool. Unexposed PMMA serves as a mask for 20 keV nitrogen-15 implantation. The implanted sample is then cleaned in a boiling mixture of nitric, sulfuric, and perchloric acid. Annealing at 850° for 2 hours allows vacancies to diffuse next to implanted nitrogen atoms, forming NV centers with an efficiency of a few percent. SRIM simulations provide nitrogen ion distribution within our diamond substrate and PMMA mask as functions of implantation energy. Thus, after balancing implantation parameters and exposure hole cross-sections, NV center placement can be achieved with accuracy limited by the precision of available electron-beam lithography equipment.

[1]Supported by the Sloan and Packard Foundations, the Army Research Office, and the National Science Foundation.

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Date submitted: 15 Nov 2013 Electronic form version 1.4