Abstract Submitted
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Optimizing the Growth of (111) Diamond for Diamond Based Magnetometry[1] ERIC KAMP, PATRICK GODWIN, NITIN SAMARTH, Pennsylvania State University, DAVID SNYDER, Pennsylvania State University Applied Research Laboratory, CHARLES DE LAS CASAS, DAVID D. AWSCHALOM, Institute for Molecular Engineering, University of Chicago — Magnetometers based on nitrogen vacancy (NV) ensembles have recently achieved sub-picotesla sensitivities [Phys. Rev. X 5, 041001(2015)], putting the technique on par with SQUID and MFM magnetometry.Typically these sensors use (100) oriented diamond with NV centers forming along all four (111) crystal orientations.This allows for vector magnetometry, but is a hindrance to the absolute sensitivity. Diamond grown on (111) oriented substrates through microwave plasma enhanced chemical vapor deposition(MP-CVD) provides a promising route in this context since such films can exhibit preferential orientation greater than 99% [Appl. Phys. Lett.104, 102407(2014)]. An important challenge though is to achieve sufficiently high NV center densities required for enhancing the sensitivity of an NV ensemble magnetometer.We report systematic studies of the MP-CVD growth and characterization of (111) oriented diamond, where we vary growth temperature, methane concentration, and nitrogen doping. For each film we study the Nitrogen to NV ratio, the NV^- to NV^0 ratio, and alignment percentage to minimize sources of decoherence and ensure preferential alignment. From these measurements we determine the optimal growth parameters for high sensitivity, NV center ensemble scalar magnetometry.

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