Abstract Submitted
for the MAR14 Meeting of
The American Physical Society

Mitigating surface-induced decoherence of spin sensors in nitrogen delta-doped diamond[1] BRYAN A. MYERS, MATTHIEU C. DARTIAILH, KENICHI OHNO, DAVID D. AWSCHALOM, ANIA C. BLESZYNSKI JAYICH, Center for Spintronics and Quantum Computation, University of California, Santa Barbara, CA — The negatively-charged nitrogen-vacancy (NV) center in diamond is a robust nanoscale sensor of magnetic fields. To maximize their sensitivity to external spins, NVs have to be located close to the diamond surface while mitigating surface-induced decoherence. This requires a quantitative understanding of the dominant noise origins, which are currently not well understood. To address this we create shallow NVs by delta-doping during CVD growth [1] and apply scanning probe-based magnetic resonance imaging to find their depths with nm precision. We probe the noise with dynamical decoupling (DD) control of the NVs and fit their coherence decay envelopes to a spin-bath model with two contributions: bulk and surface electronic spins. The fits yield a surface spin density $\sigma_{\mathrm{s}} = 0.0032/\mathrm{nm}^2$ and relaxation rate $1/\tau_{\mathrm{s}} = 190$ kHz. We find an optimal CPMG-4 passive detection sensitivity of 250 $\mu_{\mathrm{p}}/\sqrt{\mathrm{Hz}}$ for an NV at 14 nm depth. Doped NVs within 10 nm of the surface were progressively decoupled from noise in the $1/\tau_{\mathrm{s}}$ frequency regime using shorter DD inter-pulse delays, thereby enhancing their sensitivity.

[1] K. Ohno et al., Appl. Phys. Lett. 101, 082413 (2012).

[1]This work was supported by DARPA QuASAR, AFOSR YIP, Bruker, and a Department of Defense NDSEG fellowship.

Bryan A. Myers
Center for Spintronics and Quantum Computation,
University of California, Santa Barbara, CA

Date submitted: 15 Nov 2013 Electronic form version 1.4