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Development of single-crystal diamond scanning probes with nitrogen-vacancy centers for cryogenic magnetometry with nanoscale spatial resolution ALEC JENKINS, MATTHEW PELLICCIONE, PREETI OVARTCHAIYAPONG, CHRISTOPHER REETZ, ANIA BLESZYNSKI JAYICH, University of California, Santa Barbara — Scanning probes based on the nitrogen-vacancy (NV) defect center in diamond are powerful tools for imaging magnetic phenomena at the nanoscale. In particular, extending the operation of these probes to cryogenic temperatures opens up a wide range of condensed matter systems that can be studied. In this talk, we demonstrate a variable temperature NV scanning magnetometer consisting of an atomic-force microscope housed in a closed-cycle cryostat integrated with custom confocal optics. With this microscope we have observed 6-nm spatial resolution and 3 $\mu\mathrm{T}/\sqrt{\mathrm{Hz}}$ sensitivity at $T = 6$ K. The single-crystal diamond scanning probes that contain shallow and coherent NV centers are critical to the performance of the microscope. The probes are designed with the aim of reducing the NV-sample separation and increasing collection of NV fluorescence, both while maintaining the spin coherence properties of the defects. We describe the fabrication of these probes as well as ongoing efforts to improve their sensitivity and spatial resolution.

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