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Development of a ^{3}He Nuclear Magnetic Resonance Force Microscope* MARK MONTI, HAN-JONG CHIA, YONG LEE, JOHN MARKERT, Department of Physics, University of Texas at Austin — We report on construction of a ^{3}He Nuclear Magnetic Resonance Force Microscopy (NMRFM) probe for nanoscale scanning and relaxation-time applications. Dual 3-axis piezo-driven stages yielded nanoscale positioning precision across several millimeters. We performed measurements on ^{1}H nuclei in single crystal $(NH_4)_2SO_4$ in a sample-on-oscillator configuration at room temperature. A 0.25-mm-diameter permalloy magnet provided a field gradient of $\sim$500 T/m. The magnet position was scanned to achieve resonance; the RF frequency was also independently varied to verify the NMR nature of the force-detected signal. These first tests used a commercial AFM cantilever with a loaded resonance frequency of 2.0 kHz and spring constant of $\sim$0.03 N/m; motion was detected with a laser interferometer (1310 nm). Using cyclic adiabatic inversion (CAI), we detected a nuclear moment of 1.9 $\times 10^{-16}$ J/T with SNR $\approx$ 6. By preceding the CAI sequence with a short, variable-length pulse, a spin nutation signal was observed over several cycles of period 17 μs, implying a rotating RF field of 14 G. Using a $(\pi/2)$-τ-π-t-$\pi/2$-CAI sequence, a spin-echo was mapped out, with a FWHM of 8 μs. We also discuss plans to extend measurements towards the base temperature of the probe, 0.3 K. *This work was supported by NSF Grant Nos. DMR-0605828 and DGE- 0549417.

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