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Developing Nuclear Magnetic Resonance Force Microscopy (NMRFM) as an Electronic Probe of Nanoscale Condensed Matter Systems

JEREMY W. PASTER, DANIEL M. TENNANT, SHIRIN MOZAFFARI, JOHN T. MARKERT, Department of Physics, The University of Texas at Austin — The investigation of NMR via magnetic force coupling in a large field gradient has led to vast improvements in spatial resolution over the conventional inductive method. It has been demonstrated that nanoscale force sensors could be scaled to distinguish a single nuclear spin, assuming experimental noise can be minimized and other specious force signatures stifled. Accordingly, there are many efforts aimed at repurposing NMR for 3D imaging on the atomic scale [1]. In addition to proof-of-concept experiments aimed at separately resolving some of the eventual experimental barriers to atomic resolution, some of us have directed our attention to using NMR to probe the electronic environment in larger condensed matter systems which are not well suited for other scanning probe microscopy techniques and which are prohibitively small for inductive NMR detection. Previously, we proposed using NMRFM to probe superconducting transitions in microcrystals. In parallel, we revamped our investigation of thin films [2] to explore two-dimensional conducting interfaces between insulating oxides. Presented here is a survey of the technical impediments as well as current strategies for unlocking this exciting potential for NMRFM, as a tool to investigate sub-surface electronic transport in microscale and nanoscale condensed matter systems.

[1] Sidles JA, *Appl. Phys. Lett.* 58: 2854, 1991.
[2] Choi JH *et al.*, *Proc. SPIE* 5389: 399, 2004.

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