MAGNETIC RESONANCE FORCE MICROSCOPY: THE QUEST FOR A MOLECULAR STRUCTURE MICROSCOPE

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Is it possible to build a microscope that can look below surfaces and image molecules and materials with atomic resolution in three dimensions? Magnetic resonance force microscopy (MRFM) is an attempt to address this ambitious goal. We describe the basic principles of MRFM, with an emphasis on the detection of small ensembles of nuclear spins. As part of this work, we have developed magnetic tips that produce field gradients in excess of 1.4 million tesla per meter (14 gauss per nanometer), developed improved methods for manipulating nuclear spins and implemented a method of mitigating spin noise in statistically polarized spin ensembles. Prospects and challenges of extending MRFM to single nuclear spins will also be discussed.