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Magnetic dipole-dipole sensing at atomic scale using electron spin resonance STM T. CHOI, W. PAUL, IBM Almaden Research, S. ROLF-PISSARCZYK, Max Planck Institute, Germany, A. MACDONALD, U. of British Columbia,Canada, K. YANG, Chinese Academy of Sciences, F.D. NATTERER, EPFL, Switzerland, C.P. LUTZ, A.J. HEINRICH, IBM Almaden Research — Magnetometry having both high magnetic field sensitivity and atomic resolution has been an important goal for applications in diverse fields covering physics, material science, and biomedical science. Recent development of electron spin resonance STM (ESR-STM) promises coherent manipulation of spins and studies on magnetic interaction of artificially built nanostructures, leading toward quantum computation, simulation, and sensors In ESR-STM experiments, we find that the ESR signal from an Fe atom underneath a STM tip splits into two different frequencies when we position an additional Fe atom nearby. We measure an ESR energy splitting that decays as $1/r^3$ (r is the separation of the two Fe atoms), indicating that the atoms are coupled through magnetic dipole-dipole interaction. This energy and distance relation enables us to determine magnetic moments of atoms and molecules on a surface with high precision in energy. Unique and advantageous aspects of ESR-STM are the atom manipulation capabilities, which allow us to build atomically precise nanostructures and examine their interactions. For instance, we construct a dice *cinque* arrangement of five Fe atoms, and probe their interaction and energy degeneracy. We demonstrate the ESR-STM technique can be utilized for quantum magnetic sensors.

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