

Spin sensing and magnetic design at the single atom level

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Unraveling many of the current dilemmas in nanoscience hinges on the advancement of techniques which can probe the spin degrees of freedom with high spatial, energy, and ultimately high temporal resolution. With the development of sub-Kelvin high-magnetic field STM, two complementary methods, namely spin-polarized scanning tunneling spectroscopy (SP-STs) [1] and inelastic STs (ISTS) [2-3], can address single spins at the atomic scale with unprecedented precision. While SP-STs reads out the projection of the impurity magnetization, ISTs detects the excitations of this magnetization as a function of an external magnetic field. They are thus the analogs of magnetometry and spin resonance measurements pushed to the single atom limit. I have recently demonstrated that it is possible to reliably combine single atom magnetometry with an atom-by-atom bottom-up fabrication to realize complex atomic-scale magnets with tailored properties [4-6] on metallic surfaces [1,7]. I will discuss the current state of the art of this growing field as it pertains to single spin information storage, and how the functionality of coupled magnetic adatoms can be tailored on surfaces. Finally, I will present an outlook on future perspectives in the field of single atom magnetism and the promising application of single spin detection to broader scopes in nanoscience as a whole.

[1] A.A.K., et al., *PRL*, 106, 037205 (2011); [2] A. J. Heinrich, et al., *Science*, 306, 466 (2004); [3] A.A.K., et al., *Nature*, 467, 1084 (2010); [4] A.A.K., et al., *Nature Physics*, 8, 497 (2012) [5] A.A.K., et al., *Science*, 332, 1062 (2011), [6] A.A.K., et al., *Science*, 339, 55 (2013), [7] A.A.K., et al., *PRL*, 111, 126804 (2013).

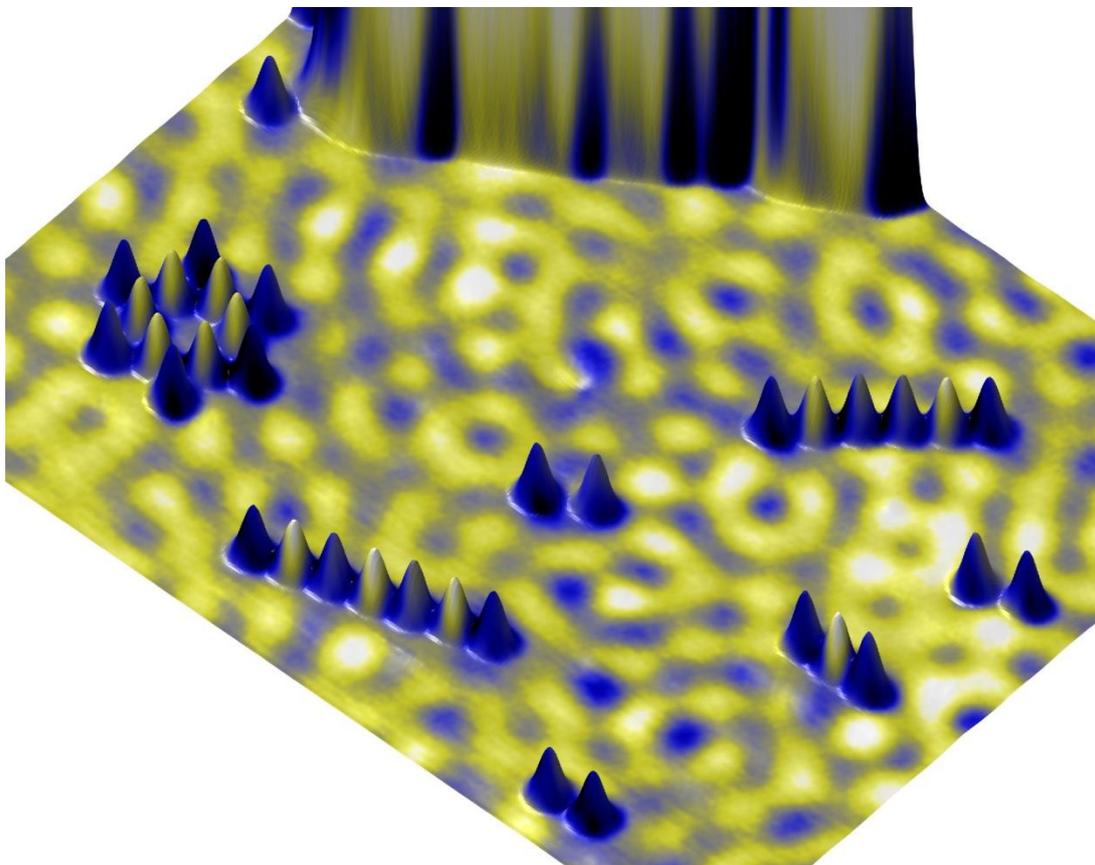


Figure 1: "Magnetic LEGOs:" Spin-polarized scanning tunneling microscopy image of artificially coupled arrays of Fe atoms on the Cu(111) surface.