

# Manipulation of Charge, Spin and Conformation in Single Atoms and Molecules

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We combine a variety of scanning tunneling microscope (STM) manipulation schemes with tunneling spectroscopy techniques to investigate and to manipulate properties of atoms and molecules on surfaces. This talk will include our recent results and achievements: In spintronic area, we will show that a magnetized STM tip can be used not only to manipulate individual atoms maintaining magnetic contrast but also imaging of their spin directions is possible [1]. In nanoscale superconductivity area, we will present the smallest molecular superconductor ever studied to date. Here, the finding of superconductivity in just four pairs of (BETS)2-GaCl4 molecules opens the possibility of investigating superconducting phenomena locally[2]. In molecular machines area, entangled and synchronized rotations of artificial molecular rotors operated by using the electric field from an STM tip will be presented. These experiments are innovative, and are tailored to address several critical issues covering both for fundamental understanding, and for demonstration of novel atom/molecule based nanodevices.

[1]. D. Serrate, P. Ferriani, Y. Yoshida, S.-W. Hla, M. Menzel, K. von Bergmann, S. Heinze, A. Kubetzka, and R. Wiesendanger. Imaging and Manipulating the Spin Direction of Individual Atoms. *Nature Nanotechnology* 5 (2010) 350-354.

[2]. K. Clark, A. Hassanien, S. Khan, K.-F. Braun, H. Tanaka, and S.-W. Hla. Superconductivity in Just Four Pairs of (BETS)2-GaCl4 Molecules. *Nature Nanotechnology* 5 (2010) 261-265.