Doping a single molecule magnet with the tip of a scanning tunneling microscope

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Functional molecules are foreseen as a potential replacement to diodes, transistors, or switches, providing a well-defined control of the molecular functionality is achieved by means of hybrid metal-organic circuits. In particular single molecule magnets (SMM: large magnetic anisotropy, slow relaxation of the magnetic moment) are showing interesting quantum effects that makes them suitable candidates in supramolecular electronics for quantum computing and magnetic data storage [1]. Doping with metal atoms impacts the quality of the electronic devices and represents an important issue in molecular electronics. In this thesis work a surface supported mononuclear metal complex [2] (Fig. 1) behaving like a SMM will be used to understand to which extent the doping with atoms, alters the electronic properties of the complex. The measurements are carried out at low temperature and in ultrahigh vacuum to ensure a clean and reproducible experimental environment. Our approach consists in using a low temperatures scanning tunneling microscope (STM) equipped with a vector magnetic field to accurately map the local electronic properties of a single molecule. Recent work of the team with a very high spatial and energy resolution can be found in ref. [3].

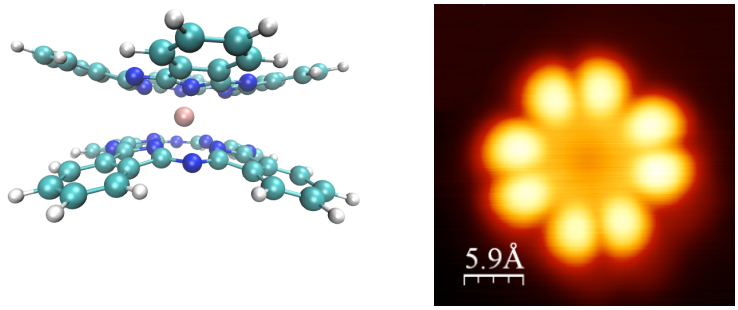

Figure 1: Schematic view of $TbPc_2$ molecule magnet with its sandwiched Tb atom in the gas phase and the STM topography of the same molecule when deposited on a Au(111) surface.

In this thesis, atomic manipulation with the STM tip will be used to carefully move the adsorbed atoms to the dopant site of the molecule. In particular, this approach offers a new route towards selective charge and spin doping at the molecular scale [4], multiple doping may lead to striking metal-insulator transitions. The candidate will participate in an ambitious multi-partner project. The molecules are synthesized in the group of Prof. M. Ruben (Karlsruhe Institute of Technology and IPCMS). Theoretical support is provided by the team of Dr. K. Fink (INT Karlsruhe). We are looking for a highly motivated candidate with a scientific master degree. He/she should have a good background in physics or physical chemistry, and a sound knowledge of material science.

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[2] L. Vitali, S. Fabris, A. Mosca, S. Brink, M. Ruben et al. *Nano Letters* **8**, 3364 (2008).
[3] S. Kezilebieke, A. Amokrane, M. Abel, J.P. Bucher, J. *Phys. Chem. Lett*. **5**, 3175, (2014) and S. Kezilebieke et al., *Nano Research* **7**, 888 (2014).
[4] C. Krull et al. *Nature Materials,* **12**, 337 (2013).