Mechanics with single molecules: Manipulation with the STM tip

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Mechanical molecular systems can provide an alternative route to transmit information at the nanoscale and could compete in terms of high-clock frequency and robustness to radiations with electronic, optical and magnetic devices. STM at low temperature is a powerful tool to study mechanics at the nanoscale, because it combines on-surface chemistry to synthetize complex molecules in an ultraclean environment, molecular assembly to form ordered complex nanostructures, and atomic-scale manipulation to study conformational changes and mechanical properties of single molecules.

In this talk, recent results will be reviewed, where single molecules and molecular nanostructures are formed on surface and manipulated by tunneling electrons on metallic and semiconducting surfaces. The transmission of motion between molecules will be discussed, towards the construction of molecule-machines.

In particular, hydrogen-bonded supramolecular nanostructures can be precisely moved on a gold surface by voltage pulses applied through the STM tip [1]. Such nanostructures can generate work by moving the load of a single atom [2].

Figures

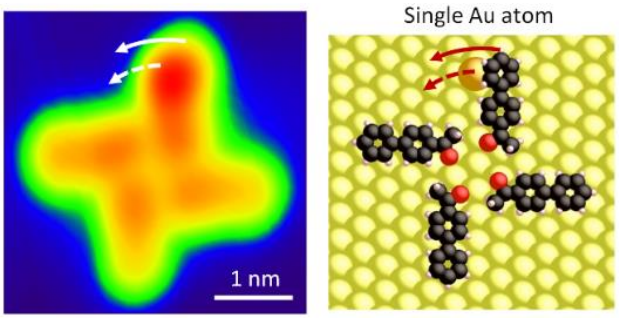

Figure 1. A supramolecular nanostructure composed of four 4-acetylbiphenyl molecules and self-assembled on Au (111) was loaded with single Au adatoms and studied by STM. By applying voltage pulses to the supramolecular structure, the loaded Au atoms can be rotated and translated in a controlled manner.

References

[1] A. Nickel, R. Ohmann, J. Meyer, M. Grisolia, C. Joachim, F. Moresco, G. Cuniberti, ACS Nano 7 (2013) 191

[2] R. Ohmann, J. Meyer, A. Nickel, J. Echeverria, M. Grisolia, C. Joachim, F. Moresco, G. Cuniberti, ACS Nano, 9 (2015) 8394