Highly ordered molecular adsorbate layers on metal surfaces: From surface science to molecular electronics

F.S. Tautz, R. Temirov, S. Soubatch

Institut für Bio- und Nanosysteme 3,
Forschungszentrum Jülich, 52425 Jülich, Germany

Molecule-based electronics offers excellent prospects. Both for more traditional organic electronic devices and for state-of-the-art single molecule devices, molecule-metal contacts are of key importance. Highly ordered monolayers and thin films of on electrically active molecules on single crystal metal surfaces are excellent model systems for fundamental properties of molecule-metal contacts, because they allow the deployment of powerful surface science tools. In the first two parts of the talk, I will present an in-depth characterization of the structural and electronic properties of a well-defined metal-molecule contact and a complex, interface-stabilized organic thin film phase [1,2], the latter with particular emphasis on implication for charge carrier transport. In the third part I will show that highly ordered molecular adsorbate layers are an excellent starting point for studying electrical transport in single molecule wires: In spite of recent progress, the precise measurement of quantum transport through molecules is still a formidable challenge, but low temperature scanning tunneling microscopes (STM) forms an excellent platform for this purpose, because the STM allows selection of specific molecules, covalent contacting at predefined atoms, continuous tuning of the molecule-electrode back-contact, and a presupposition-less comparison to ab initio theory [3]. Finally, I present data which show that using transport beyond simple vacuum tunneling may also dramatically improve the information content of STM images, yielding ultra-high geometric image contrasts which are related to the chemical structure of the investigated molecule [4]

[1] PRL 100, 136103 (2008)
[2] PRL 102, 177405 (2009)
[3] Nanotechnology 19, 065401 (2008)
[4] New J. Phys. 10, 053012 (2008)