Model systems for molecular electronics studied by scanning probe microscopy

Leonhard Grill
Fritz-Haber-Institut of the Max-Planck-Society
Department of Physical Chemistry
Faradayweg 4-6, 14195 Berlin, Germany
e-mail: lgr@fhi-berlin.mpg.de

Molecules that are equipped with a specific function are of great interest for future applications in "molecular nanotechnology" where they should be used as single-molecule "devices". A detailed understanding of the molecular function when being adsorbed on a surface or in contact with other molecules is required. The scanning tunneling microscope (STM) represents a highly suitable instrument for the investigation of such molecules, because it can not only image molecules with submolecular resolution but is also capable to manipulate single molecules by chemical/electrostatic forces or electronic processes [1, 2].
A key challenge in the field of molecular electronics is the bottom-up construction of stable molecular networks with pre-defined topology and shape. Ideally, such networks should be capable of charge transport between the building blocks as individual molecules in future applications will have to be linked by conducting connections. Based on these requirements, covalent bonds are desired for the intermolecular connections, but mainly supramolecular networks have been reported on surfaces.
In this talk, various examples of manipulations of single molecules by low temperature STM will be given. The controlled assembly of functional molecules by "on-surface-synthesis" [3] will be presented, whereas the shape of the molecular nanostructures can be precisely tuned by the initial building blocks. By pulling a polymer from a metallic surface, the conductance can be measured for a single molecular wire as a continuous function of the electrode-electrode distance [4]. Finally, the adsorption and growth of such organic nanostructures on inorganic crystallites, thus creating a hybrid system [5], will be discussed.

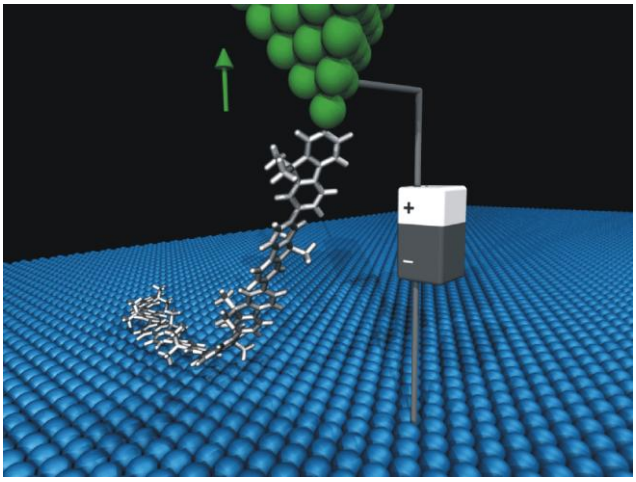

Fig.1: Scheme of the pulling of single molecules from a gold surface. By applying a bias voltage, the conductance can be measured as a continuous function of the molecular length

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[2] L. Grill, Journal of Physics: Condensed Matter 22, 084023 (2010)
[3] L. Grill et al., Nature Nanotechnology **2** (2007) 687
[4] L. Lafferentz et al., Science 323, 1193 (2009)
[5] C. Bombis et al., Ang. Chem. Int. Ed. 48, 9966 (2009)