Assembly and manipulation of single functional molecules

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In order to obtain detailed understanding of physical and chemical processes at the single molecule level, the controlled manipulation of molecules on surfaces with a scanning tunneling microscope (STM) is used. Important aspects are on the one hand the influence of the molecular adsorption and configuration on the function and on the other hand the controlled linking of molecules to larger functional networks. In this presentation, the assembly and manipulation of single molecules and polymers with various molecular functions is presented. A prototype of a functional molecule is a molecular switch that can exist in various stable states with different optical/electronic properties. Single molecules can be switched on a surface by different stimuli and it turns out that the atomic-scale environment plays a fundamental role for the activity of the optical switching function, leading to surface-defined periodic switching [1]. In order to create functional polymers that act as “molecular wires”, the controlled covalent assembly of molecules by “on-surface-synthesis” is used, allowing the bottom-up construction of stable molecular networks with pre-defined topology and shape [2]. The shape of the molecular structures can be precisely tuned via the chemical structure of the initial building blocks, even enabling a hierarchical growth mode [3]. To characterize the charge transport through “molecular wires”, they are pulled off the surface with the STM tip to measure their conductance as a continuous function of the electrode-electrode distance. The conductance curves give detailed insight into the charge transport through the polymer and its mechanical properties [4]. For the case of graphene nanoribbons, the conductance of individual molecular wires could be correlated with their electronic structure and configuration [5]. The results reveal very efficient charge transport if the electron energy matches the molecular electronic states that are delocalized along the molecular wire.

References

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