

Electronic, structural and mechanical properties of single-molecules at surfaces

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Scanning probe microscopy (SPM) plays a pivotal role in investigating molecules at surfaces down to the fundamental level. The recent advances in atomic force microscopy (AFM) using terminated tips combined with scanning tunneling microscopy (STM) [1] have widened the possibility of SPM to probe the chemical structure of molecules at the intra-molecular level. Considering that tip-induced manipulation techniques nowadays allow the displacement of single-molecules over long distances, SPM techniques also appear as incontrovertible tools to engineer and characterize future single-molecule based electronic devices. In this presentation, I will briefly discuss our recent works within this scope dealing with on-surface chemical reactions observed by AFM [2], the alteration of donor-acceptor molecule character due to on-surface complex formation [3] as well as our efforts to manipulate single molecules or polymeric chains at surfaces [4-7].

[1] R. Pawlak, S. Kawai, T. Glatzel, E. Meyer. *Single Molecule Force Spectroscopy* (ncAFM, vol. 3, Springer, Japan 2015).

[2] S. Kawai *et al.* *Thermal control of sequential on-surface transformation of a hydrocarbon molecule on a copper surface.* *Nature Comm.* **7**,12711 (2016).

[3] T. Meier *et al.* *Donor-Acceptor Properties of a Single-Molecule Altered by On-Surface Complex Formation.* *ACS Nano*, (2017).

[4] S. Kawai, *et al.* *Superlubricity of graphene nanoribbons on gold surfaces.* *Science*, **351**, 957 (2016).

[5] R. Pawlak *et al.* *Single Molecule Tribology: Force Microscopy Manipulation of a Porphyrin Derivative on a Copper Surface* *ACS Nano*, **10**, 713-722 (2016).

[6] R. Pawlak *et al.* *Snake-like motion of a polymeric chain on gold*, in preparation.

[7] R. Pawlak *et al.* *Design and Characterization of an Electrically Powered Single Molecule on Gold* *ACS Nano* **11**, 9930-9940 (2017).