Seminarankündigung

Dienstag, 24. Juni 2014
15:00 Uhr
ZNN, Seminarraum EG 0.001

"Mechanical & electronic structure of molecular junctions and alternative contacting strategies"

Abstract: The formation of molecular junctions (MJs) is a dynamic process where the atomic details of the interface between the contact electrodes and the molecule(s) strongly influence its electronic properties. The variability of possible microscopic configurations and limited stability of the different arrangements make a detailed understanding of MJs delicate and limit their applicability as electronic and optoelectronic compounds. Time-dependent and spectroscopic characterizations of these systems can thus help developing a deeper insight in the mechanisms at stake.
With a Conducting Atomic Force Microscope (C-AFM), we have simultaneously investigated the electrical and mechanical properties of Au-Au and Au-molecule-Au junctions. We show that scatter plots (2D histograms) are a powerful method to correlate force with conductance. Our measurements support a scenario where, in about twenty percent of the MJs formed during a breaking cycle, the molecules migrate along the metal contacts thanks to the mobility of surface atoms. Using a mechanically-controllable break junction (MCBJ) setup operated in a liquid environment, we have recorded IV characteristics and observed current rectification effects in symmetric and asymmetric molecular junctions. From a simple analytical model, we can extract basic parameters such as the electronic coupling provided by different anchor groups. The relatively fast IV acquisition rate achieved opens the possibility to follow the evolution and symmetry changes of IV traces along a single conductance plateau. We also investigated the effect of dipolar binding groups on the formation of conductance plateaus not only during opening cycles (i.e. opening and breaking of the junction) but also during closing cycles (i.e. while pushing the contacts together). An alternative approach to contact few molecules consists in using graphene electrodes. Gold, the most commonly used metal to create MJs, presents major drawbacks such as high mobility of the surface atoms, a strong screening of a backgate potential and the existence of many possible binding geometries leading to ill-defined MJ conductances. Graphene is interesting in this context as its planarity will grant an easier access for gating experiments as well as facilitate optical and scanning probe imaging. Furthermore, it can be produced at large scale through e.g.
chemical vapor deposition (CVD). Using an electroburning process, we have recently demonstrated the fabrication of nanoscale gaps in graphene constrictions at high yield. The electrodes formed in this way are suitable for the subsequent contacting of molecules.

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