

Chemistry with Single Molecules

Leonhard Grill

Department of Physical Chemistry, University of Graz, Austria

nano-lab.uni-graz.at

The central goal of our research is the understanding of physical and chemical processes at the atomic scale. The key method is scanning tunneling microscopy (STM), which is typically done under ultrahigh vacuum conditions and at low temperatures around 5 K. This method allows first to image single atoms and molecules adsorbed on a surface with high spatial resolution in the pm range. Second, it offers the possibility to manipulate single molecules in a controlled manner, thus inducing motion or chemical processes.

In my talk, I will give an overview on the main questions in this field of research, the method of single-molecule manipulation as well as various deposition techniques. These become important if larger molecules are studied that increase in size, due to integrated functionalities. After successful, i.e. clean and intact, deposition of these molecules, we study their chemical, optical, electronic, mechanical or electric functions. The central questions are whether and how these functions can be triggered and what is the influence of the atomic-scale environment. Various examples will be discussed, ranging from chemical reactions, molecular motion and internal conformational changes to molecular switches, wires and motors. Finally, an outlook on the current and future research questions and challenges will be given.