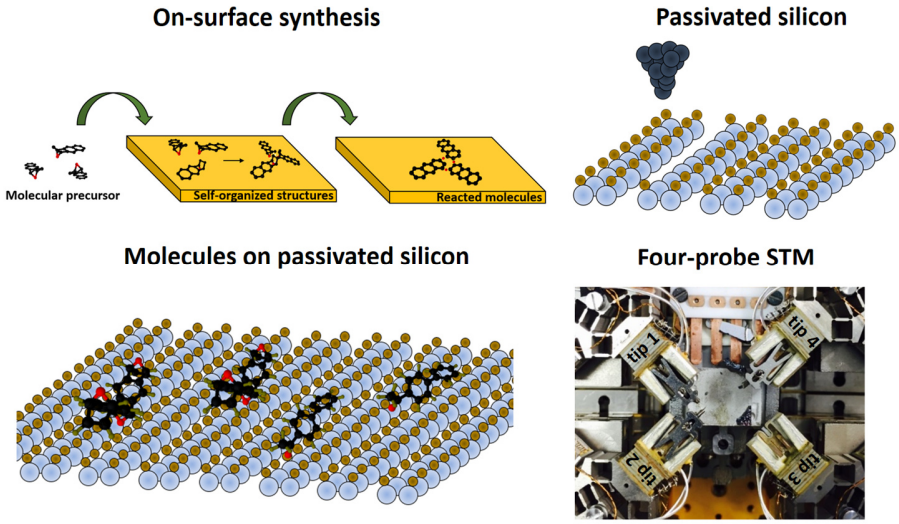
Model systems for atomic and molecular scale electronics

Frank Eisenhut

I will discuss different scientific aspects for the fabrication and addressing of planar atomic and molecular scale electronic devices on surfaces. The presented model systems are studied by using scanning tunneling microscopy (STM). With this tool surfaces, atoms and molecules can be resolved with sub-nanometer precision. In addition, the LT-UHV STM has the capability of manipulating single nano-objects and to investigate their electronic properties.



Graphical summary of the experimental results

I will discuss the on-surface synthesis approach to obtain desired molecules with specific properties on metal substrates. As one example, I will show a thermally induced debromination followed by selective ring-closure to form a five-membered ring. This lead to the synthesis of the non-alternant polyaromatic hydrocarbon diindenopyrene.

In the next part of the talk, I will present the preparation of Si(001)-(2x1):H and its characterization. The surface is of interest as it has a band gap, while electronic states of atomic defects, so called dangling bonds (DB´s), have defined electronic states in the gap. These potential building blocks for miniaturized nanoelectronic devices are controllably produced by applying voltage pulses using the tip of the STM.

I will discuss the on-surface generation of hexacene by a surface-assisted reduction of triepoxyhexacene precursors on Si(001)-(2x1):H. Additionally, I investigated acetylbiphenyl (ABP) molecules that form one-dimensional chains on this surface and show how a single ABP molecule can act as a switch that can reversibly passivate and depassivate a single DB.

Finally, I will present the stability of the new low-temperature four-probe STM located at CEMES-CNRS in Toulouse that is designed for transport measurements. I tested the sub-molecular precision of all four tips by means of a manipulation experiment of ABP molecules on Au(111).