Electron-induced manipulation and chemistry at the single molecule scale

Ignacio Pascual
Freie Universität Berlin, Germany

To induce chemical reactions energy must be provided to the molecular reactants. Thermally induced reactions are the most common chemical reactions. Here, the thermal energy of the surrounding simply “heats” the molecule and provides energy by exciting all molecular vibrations of the reactants. Photochemical reactions use the energy of incoming photons to induce the transition to the product components. In this presentation I will present an alternative method: the use of electrons to induce a chemical reaction. Using a scanning tunnelling microscope, electrons can be selectively injected into one molecule and used to provide the required energy to induce the reaction. As the tunnelling electrons are charged particles, there are two methods that these reactions can be induced: through the excitation of molecular vibrations by scattering electron-molecule, or through the attachment of the electron into the molecule, creating a molecular ion.

In this presentation I will introduce a basic conceptual approach to the field of electron induced processes on single molecules adsorbed on surfaces. The goal is to present the state of art of a new way of investigating basic chemical reactions at the nanometer scale. Rather than learning about chemistry, we learn about how to induce it locally, and how to control it. Furthermore, the seminar will include a experimental determination of the temperature a molecule can reach when electrons are injected into it. This has important implications in the field of molecular electronics, where a single molecule is expected to be able of sustaining the flow of current densities as large as 10^8 A/cm^2.