Forces and Photons in Molecular Tunneling Junctions

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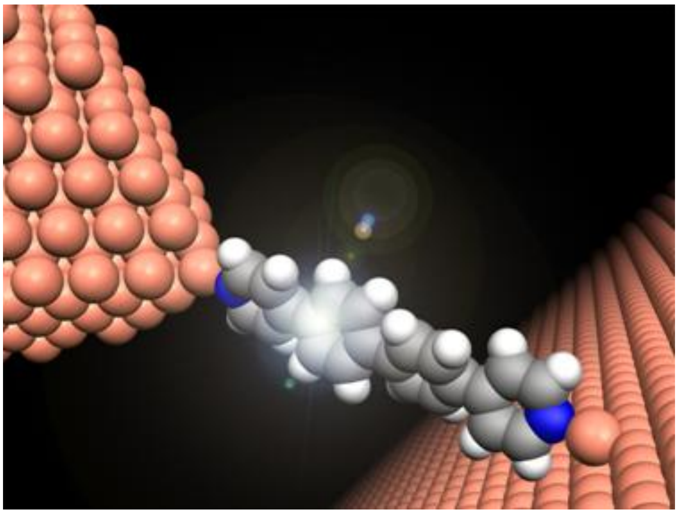
STM is an ideal probe to investigate electronic structure and excitations of individual adsorbates on surfaces. Combination of energy, space and time resolution is a powerful approach to track elementary processes involved in fields like chemistry, molecular electronics, magnetism,… Bringing the tip of a STM to contact a molecule allows us to also investigate charge transport through molecular junctions in a controlled configuration. In this talk, I will present our results regarding the formation and measurement of electronic transport through conjugated polymers hosted between a clean metal surface and the tip of the STM. We combine electron transport measurements with two additional experimental techniques to obtain additional information, simultaneously to differential conductance measurements: i) Force spectroscopy, revealing the intramolecular flexibility and deformations occurring during the formation of a molecular junction and ii) Light spectroscopy, which provides an insight into vibrational temperature induced by inelastic electrons.



- The measurement of forces at the atomic scale is done by attaching the STM tip to a stiff resonator. Interaction forces and energy can be sensed with high resolution. When investigating a molecular junction, the measurement of forces simultaneously to electrical transport, provides a new insight into the effect of molecular deformations in molecular conductance.

- Tunneling electrons also induce light emission mediated by field-enhanced plasmons at the tunnel junction. The spectroscopic characterization of emitted photons reveals “anti-stokes”-like phenomena, which we interpret as induced by hot molecular modes, excited by inelastic tunneling.