Sensing elementary processes in a molecular junction through force and light spectroscopy

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Tunnelling electrons in STM are ideal probes of electronic structure and excitations of surfaces and adsorbates. Combination of energy, space and time resolution is a powerful approach to track elementary processes involved in fields like chemistry, molecular electronics, magnetism,… However, the presence of a metal tip in the proximity of an individual molecule can go beyond electronics. Here, I will present two new approaches to molecular spectroscopy set-up recently in our laboratories at the FUBerlin: non-contact Force spectroscopy and light spectroscopy. These methods will be introduced with on-going experiments in our laboratory:

- While (electron-induced) light emission is a process mediated by field-enhanced plasmons at the tunnel junction, they also bring information about energy transitions involved in the tunnelling process through a nano-object. I will show how image states living at the surface of materials are active luminescent sources.

- 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 in molecular flexure, deformations and their relation to transport. I will present two examples: the formation of a weak bond between two molecules and the stretching of a molecular junction.