ELECTRON PHONON COUPLING; ONE GREAT SECRET OF NANO

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Inelastic electron process that leads to vibrational excitation has attracted much attention of since the conductivity of molecules bridging the electrodes is found to be strongly affected when they are vibrationally excited [1]. Considering that the conduction electrons passes through the electronic state crossing the Fermi level or hopping through the HOMO or LUMO state of the molecule, the electronic state of adsorbate should play a crucial role in the molecular electronics.

Understanding of the electron transport through a single molecule junction will be essential for the development of molecular electronics. It is indispensable that both the adsorption structure and local electronic properties be determined directly. Here we present the adsorption of benzoate (C_6H_5COO) and aminobenzoate ($NH_2C_6H_5COO$) on Cu(110) investigated using scanning tunneling microscope (STM) and scanning tunneling spectroscopy (STS). The electronic state at the contact between the molecule and the metal electrode depends not only on the functional group of molecule that attach the electrode but also the kind of the substituent and its position on the molecule strongly affects the electronic properties and their spatial distribution.

The inelastic tunneling process of electrons between the tip of an STM and the target molecule can lead to various dynamical processes at surfaces such as desorption [2], lateral hopping [3], rotation [4] and chemical reaction [5] via the excitation of vibrational modes of adsorbed molecules. The vibrational modes that are excited through the process could be defined through the response of the molecular motion to the applied bias voltage, i.e. action spectrum. Action spectra for hopping motion of cis-2-butene on Pd(110) [6], cleavage of dimethl-disulfide on Cu(111) and hopping motion of cleaved product methyl-thiol show clear thresholds in bias voltage that are equivalent to certain vibration modes, the excitation mechanism of which can be understood by the resonant tunneling mechanism. When the electron jumps into or out of a certain molecular orbital, molecules will temporally go through the negative or positive ion state. And vibration states can be excited, during the relaxation process.

References:

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