

Scanning probe microscopy of molecules on insulating films: From orbital imaging to molecular structure determination

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Ultrathin insulating films on metal substrates are unique systems to use the scanning tunneling (STM)/ atomic force microscope (AFM) to study the electronic and structural properties of single atoms and molecules, which are electronically decoupled from the metallic substrate. In the case of STM of molecules the electronic decoupling allows the direct imaging of the molecular frontier orbitals [1]. In combination with atomic/molecular manipulation this opens up the possibility to study elementary processes related to charge state control, molecular switching and electrical contact formation. Detailed structural and charge state information can be attained by Atomic Force Microscopy [2, 3] which leads to the direct imaging of the molecular geometry. The key to such high lateral resolution are specific AFM tip terminations (for example CO transferred to the tip by atomic manipulation) to tune the interaction of the tip with the adsorbed molecule. It will be shown that this technique has the prospect to determine the molecular structure of an unknown molecule [4]. The reversible bond formation between a gold adatom and a PTCDA molecule constitutes a reliable molecular switch [5]. The combination of STM and AFM is a unique tool to study the operation of this molecular switch resolving the details of the bond formation/breaking processes on the atomic scale.

References

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