

Fast conductance switching of triazatruxene molecules on Ag(111) controlled by hydrogen bonding

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Realization schemes for tuning the electronic and magnetic properties [1] as well as for the control of molecular motion on surfaces [2,3] are of crucial importance for the fabrication of molecule-based functional devices. One possibility to controllably tune the properties of individual molecules rely on the atomically-precise manipulation of the environment of molecules.

Here we investigate triazatruxene (TAT) molecules on Ag(111) by low temperature scanning tunnelling microscopy (STM) and spectroscopy (STS). After the deposition by means of electro spray ionization on Ag(111), STM measurements show three different types of molecular appearance on Ag(111) which we assign to pristine TAT and TAT molecules with one and two additional hydrogen atoms attached (Fig. 1). Time resolved current measurements at individual pristine TAT molecules reveal a *electron/current-induced telegraph noise* behaviour, characteristic for switching between two well-defined states (high and low current). The observed noise is localized at three nitrogen atoms of a TAT molecule and is attributed to the switching between states of different adsorption geometry and orbital population. The switching process shows a very small threshold energy and very high switching rates which strongly depend on tunnelling voltage and current. For the TAT molecules with additional hydrogen atoms attached we observe a strong suppression of the characteristic switching as well as the suppression of the lateral mobility of TAT molecules. We attribute this observation to the formation of hydrogen bonds between the TAT molecule at the nitrogen site and the Ag(111) substrate, which stabilize a different adsorption geometry. We further show the possibility to controllably initiate or suppress the switching process by detaching or attaching hydrogen to nitrogen atoms of TAT.

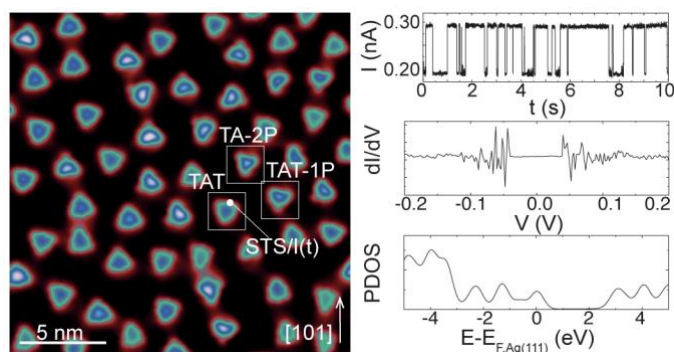


Figure 1 Left-hand-side: STM image of TAT/Ag(111) displaying three different molecular appearances. Right-hand-side: time-resolved current measurements on a pristine TAT molecule exhibiting telegraph noise; scanning tunneling spectra showing characteristic noise pattern above a certain threshold energy; calculated paraprojected density of states for TAT/Ag(111).

References:

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