HIGH-RESOLUTION AFM/STM IMAGES: BEYOND IMAGING

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High-resolution AFM/STM images of molecules acquired functionalized tips [1,2] created a lot of excitement among researchers from many fields including material science, physics and chemistry. So far, the method has been mostly used to visualize chemical structures of molecules on surfaces, but quantitative information is mostly missing. Further proliferation of the technique depends critically on our ability to extract novel information or characterize/identify complex molecular structures.

In this talk, we will address both questions. First we will discuss a novel technique that maps out the electrostatic potential over a single molecule with unprecedented resolution [3]. The technique exploits the fact that image distortions typically observed in high-resolution atomic force microscopy images are for a significant part due to the electrostatic force acting between the tip and the charge distributed in the molecule of interest [4]. In addition, we report sub molecular resolution of water clusters achieved with AFM, which indicates that the H-bonded water systems remain intact during the high-resolution AFM imaging. What more, the AFM images provide information about chiral character of the electrostatic field of the water clusters.

In the second part, we will exploit the high-resolution images to identify the individual chemical products of on-surface reaction. What more, we will demonstrate chirality transfer from a homochiral helical precursor to enantiofacially adsorbed prochiral products through a cascade of stereoconservative on-surface reactions (see Fig.). We believe that the possibility to form globally enantiopure assemblies of prochiral molecules through on-surface synthesis opens a new way of expressing 2D chirality in so far unexplored types of organic-inorganic chiral surfaces.

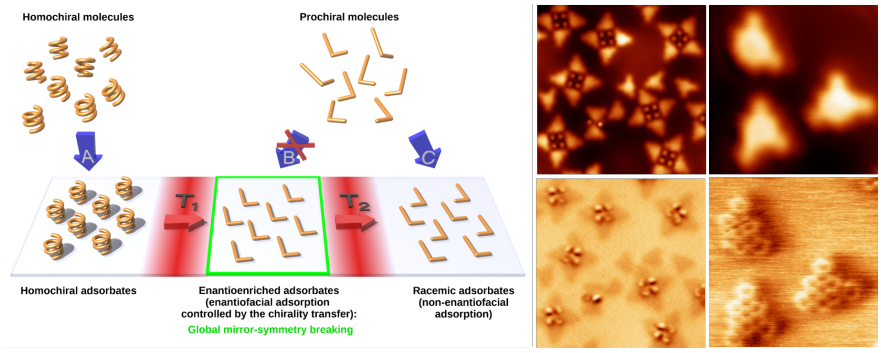

Fig. Right: The proposed concept of global mirror-symmetry breaking in the system of prochiral molecules on an achiral substrate through controlled on-surface chemistry reaction. Left: High-resolution AFM/STM images of different products of the chemical reaction.

Keywords: AFM; STM; Chirality; water; electrostatic field; DFT; sub molecular resolution

References

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