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Applications of AFM for atomic manipulation and spectroscopy

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Since the first demonstration of atom-by-atom assembly [1], atomic manipulation with scanning tunneling microscopy has yielded stunning realizations in nanoscience. A new exciting panorama has been recently opened with the possibility of manipulating atoms at surfaces using atomic force microscopy (AFM) [2-5]. In this talk, we will present two different approaches that enable patterning structures at semiconductor surfaces by manipulating individual atoms with AFM and at room temperature [2, 3]. We will discuss the physics behind each protocol through the analysis of the measured forces associated with these manipulations [3-5]. Another challenging issue in scanning probe microscopy is the ability to disclose the local chemical composition of a multi-element system at atomic level. Here, we will introduce a single-atom chemical identification method, which is based on detecting the forces between the outermost atom of the AFM tip and the atoms at a surface [6]. We demonstrate this identification procedure on a particularly challenging system, where any discrimination attempt based solely on topographic measurements would be impossible to achieve.

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