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Probing electronic and magnetic properties of atomic and molecular clusters with sharp tips[1]

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Probing magnetic and transport properties on a local basis with the tip of a scanning tunneling microscope (STM) allows establishing close links with the exciting field of magnetic read and write processes. Some examples of applications of this approach to magnetic nanostructures will be shown. First of all, the fundamental properties of Co nanoclusters, on metal surfaces will be presented. These clusters have been probed by low temperature dI/dV spectroscopy (STS). It is found that occupied electronic surface states of the Co clusters are sensitive to the crystallographic stacking and furthermore exhibit a downward energy shift as the cluster size decreases. *Ab initio* calculations confirm that the observed shift is due to the size dependent mesoscopic relaxation in the clusters. When a magnetic tip is used in low temperature spin polarized (SP)-STM experiment, it is possible to reveal spin polarized feature in the local density of states. For example, one is able to identify two magnetization states of the nanometer Co clusters, corresponding to the parallel or antiparallel configuration with respect to the tip polarization. Progress in the emerging field of spintronics strongly relies on the fundamental understanding of electron/spin transport and magnetic phenomena in reduced dimensions, down to the extreme limit of individual molecules, or even single atoms where sizeable quantum effects are expected. Electronic and magnetic properties of Co atoms and metal-based molecular magnets adsorbed on magnetic nano-islands or on non magnetic surfaces will be presented. On the example of Co-phtalocyanines prepared in UHV at 4.6 K, it will be shown that dI/dV characteristics are representative of both, the nature of the molecule and also its interaction with the substrate.

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