Mapping magnetism with a molecule

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The decoration of metal probe-tips by a molecule intentionally picked up from a surface has proven to be a powerful method to improve the measurement capabilities of a scanning tunneling microscope (STM). The success of this approach opens the prospect of introducing spin sensitivity through the tip functionalization by a magnetic molecule. We show here that a metallocene-terminated tip can probe surface magnetism through the inelastic component of the tunneling current, which provides an electrical access to the metallocene spin states. When the tip is 100 picometers away from point contact, the exchange interaction between the tip and a magnetic sample changes the metallocene spin states. This detection scheme can then be used to independently measure the sample exchange field and spin polarization with atomic-scale resolution with knowledge of spin orientation as we show on ultra-thin cobalt layers.



Fig. 1. STM tip functionalized with a Nickelocene molecule. Below a Cobalt island grown on Copper which features an out-of-plane magnetization.