# Magnetic Exchange Force Microscopy and Spectroscopy - A Novel Technique to Study Magnetism with Atomic Resolution

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Magnetism on the nanoscale exhibits new phenomena due to the reduced dimensionality and the presence of surfaces as well as interfaces. For example, single atoms often exhibit a very strong anisotropy energy, e.g., Co adatoms on Pt(111), which can exceed bulk values by orders of magnitude. At interfaces spin-orbit coupling between a non-magnetic substrate and a magnetic overlayer can induce a new magnetic order, e.g., Fe, the prototypical bulk ferromagnet, orders antiferromagnetically if deposited as a monolayer on W(001). Some non-magnetic surfaces show a rather exotic magnetic behavior on its own, e.g., the pseudospin in graphene and the spin-orbit coupling in the surface state of topological insulators.

In this presentation magnetic exchange force microscopy (MExFM), which is a rather new technique that can be used to study magnetism with atomic resolution, will be introduced [1,2]. Unlike spin-polarized scanning tunneling microscopy (SP-STM) this technique is not restricted to conductive samples, but can be applied on insulating surfaces, e.g., oxides, as well [1]. Moreover, with its spectroscopic mode (MExFS) it is possible to directly measure the distance dependence of the magnetic exchange interaction [3]. This knowledge can then be utilized to manipulate the magnetic state by adjusting the strength via the distance dependence [4]. Recent results on NiO(001) and Fe/W(001) will be reported.

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