Structural flexibility of ultrathin iron oxide islands and films on Ru(0001)

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Iron oxides are the well-known magnetic materials which, depending on the crystalline phase, exhibit ferromagnetic or antiferromagnetic ordering. In the case of ultrathin ($<$ 1 nm-thick) iron monoxide (FeO) islands and films, the structure and magnetic properties may be additionally determined by the limited thickness and the interaction with the underlying substrate. Such species are also prone to oxidation/reduction when subjected to oxidizing/reducing conditions, which is related to the different possible oxidation states of iron and the structural flexibility of nanometer-sized structures. We used scanning tunneling microscopy (STM), low energy electron diffraction (LEED) and X-ray photoelectron spectroscopy (XPS) to study the structural evolution of the FeO/Ru(0001) system upon exposure to atomic oxygen (oxidation) or high-temperature annealing under ultra-high vacuum (UHV) (reduction). The results revealed the transformation of FeO into an oxygen-rich ("FeO_2") or oxygen-poor ("Fe_2O") phase upon oxidation/reduction, respectively [1,2]. The experimental findings are supported by density functional theory (DFT) calculations on the crystallographic, electronic and magnetic structure of different iron oxide films on Ru(0001).

References:

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