

Magnetic properties of Fe nanostructures on Ru(0001) and Rh(111) studied by XMCD

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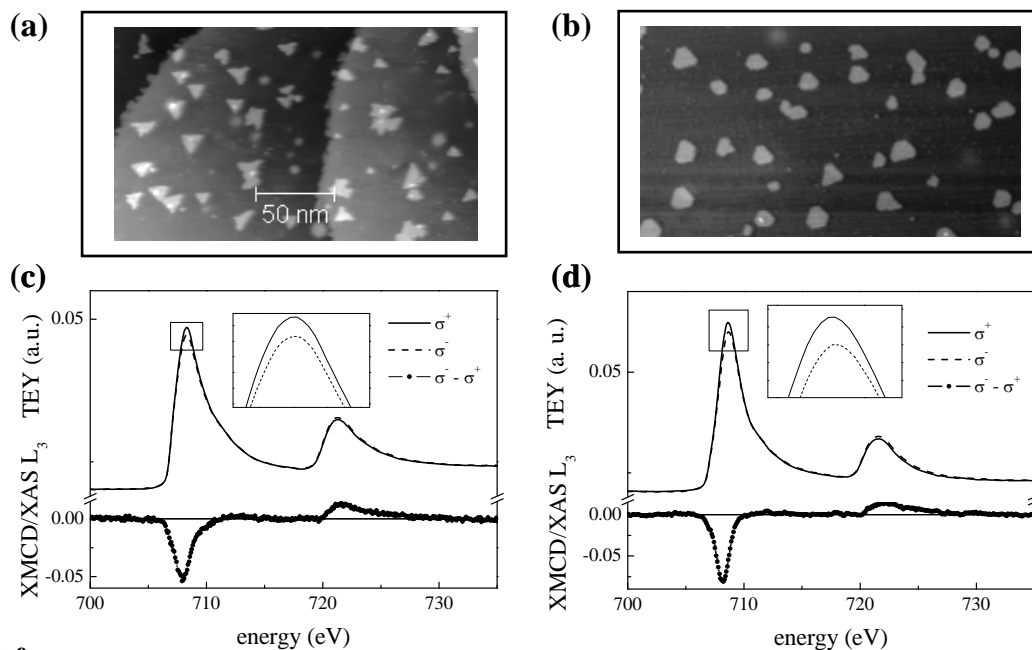
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Motivated by a theoretical study published in 2009 by B. Hardrat et al. [1], we have investigated the magnetic properties of Fe nanostructures grown on Ru(0001) and Rh(111) substrates. According to calculations, as a result of spin spiral structures with q vectors corresponding to wavelengths of several atomic distances, the magnetic configuration of an epitaxial Fe monolayer is a 120° Néel structure in case of Fe on Ru(0001) and a double-row-wise antiferromagnetic (AFM) structure in case of Fe on Rh(111). Thus, epitaxial Fe islands with a width of about 1-2nm are expected to show AFM alignment of the spins, differently from ferromagnetic (FM) bulk Fe.

We have studied morphology and magnetism of compact Fe islands grown on Ru(0001) and Rh(111) single crystals. An example of the system's morphology is shown in Figs. (a-b). X-ray Magnetic Circular Dichroism (XMCD) experiments revealed that the magnetic coupling between Fe atoms in compact Fe islands is different than in bulk. In particular, as seen in Figs. (c-d), a very low XMCD has been measured, even 10 times smaller than in bulk Fe. This indicates an AFM rather than FM coupling. Another interesting aspect concerns the role of disorder in the AFM coupling, which can be studied by allowing the Fe-Fe distances to vary randomly. We will show that quenched condensed Fe impurities are only weakly AFM.

Figure Top: Scanning Tunneling Microscopy images of Fe islands on Ru(0001) (a) and Rh(111) (b); Bottom: Corresponding X-ray Absorption Spectra for positive and negative circular polarization and dichroism, for Fe islands on Ru(0001) (c) and on Rh(111) (d).



References

[1] B. Hardrat, A. Al-Zubi, P. Ferriani, G. Bihlmayer, S. Blügel, and S. Heinze, *Complex magnetism of iron monolayers on hexagonal transition metal surfaces from first principles*, Phys. Rev. B **79**, 094411 (2009).

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