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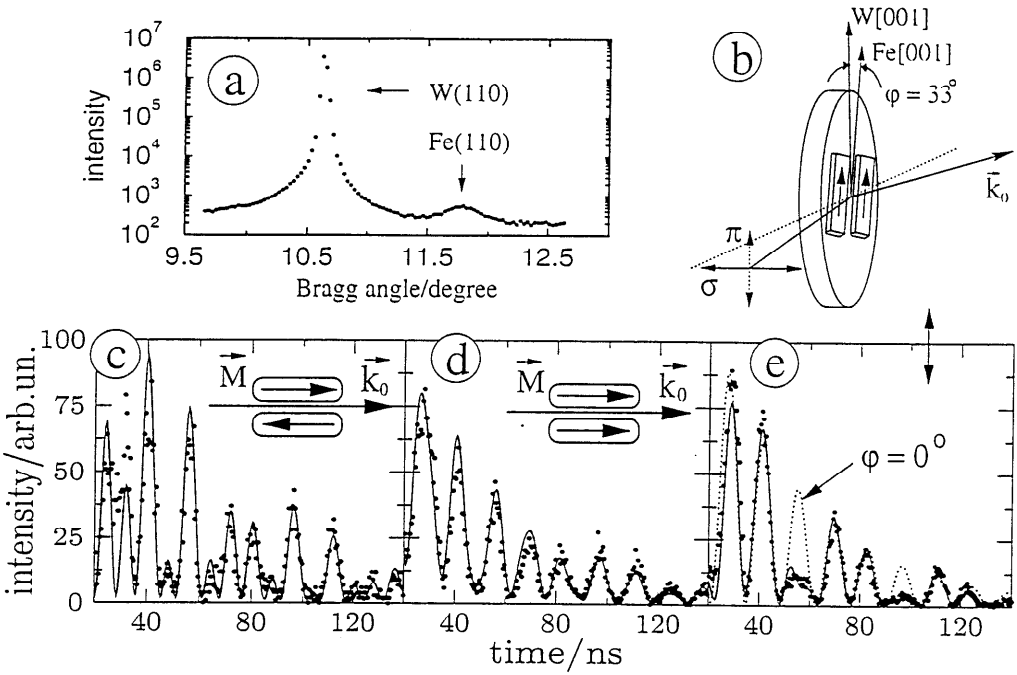
We studied the magnetism of ^{57}Fe islands on W(110) by nuclear resonant forward scattering of 14.4keV linearly polarized synchrotron radiation at the ID18. The iron island system has been prepared under ultrahigh vacuum conditions by thermal evaporation of iron from a crucible onto a clean W(110) single crystal followed by a heating to about l000K in order to create iron islands. At these temperatures iron on tungsten forms separated and well ordered 3D Fe islands on a pseudomorphically ordered iron monolayer on W(110). The iron islands are of bcc(110) type with the lattice constant of bulk iron as revealed from a diffraction experiment, cf. Fig. (a). Furthermore, these islands are atomically flat on top and of rectangular shape with the long axis pointing along the W[00l] direction. The preparation of the island system has been checked in-situ with LEED, Auger spectroscopy and Scanning Tunneling Microscopy. Afterwards the tungsten crystal has been capped with a carbon film of about 10 nm in order to prevent oxidation of the iron islands ex-situ. The technique of nuclear resonant scattering is sensitive to the magnetic field at the nuclei and yields much higher efficiency when compared to the typically used conversion electron Mossbauer spectroscopy CEMS. The sample was illuminated in grazing incidence at an angle of 4.6mrad, corresponding to the critical angle of tungsten.

The quantum beats in the time resolved spectra of the reflectivity clearly prove the internal magnetic field of the islands to be equal to the bulk **value** (B=33.3T). Moreover. the shape of the quantum beat pattern is very sensitive to the magnetic orientation of the islands. as shown for different geometries. in figs. (c-e). Fig. lc corresponds to the native state where the moments of the individual islands are aligned antiparallel to minimize their total energy. After remanent magnetization by a short current pulse through a coil close to the sample, the islands are magnetized parallel as indicated in Fig. (b).



In contrast to our assumption that the easy magnetization axis of the iron islands is pointing along the W[00l] direction (i.e., φ=0), we extracted an in-plane deviation of about 33° by comparing the data (in the geometry with the greatest sensitivity, Fig. e) to our calculations [1,2]. This phenomenon could be induced in three different ways: (1) a change in the magnetic anisotropy induced by the carbon overlayer; (2) diffusion of carbon from the overlayer into the iron islands leading to a rotation of the easy magnetization axis for the compound or (3) a contamination of the tungsten surface yielding in a different growth mode of the iron islands.

References:

[1] W. Sturhahn, E. Gerdau, Phys. Rev. B 49 (1994) 9285
[2] R. Röhlsberger, PhD-thesis Univ. Hamburg (1994), HASYLAB Internal Report 94-06