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Report:

We report our first experiment on the study of thin film magnetic microstructures carried out at the ESRF's helical undulator beamline. The contrast mechanism we employ for magnetic imaging is magnetic circular dichroism in soft x-ray absorption at the 3-d transition metal $L_{2,3}$ absorption edges, applied in a newly developed photoelectron emission microscope (FOCUS IS-PEEM). The gray-levels of the acquired images can be linearly translated to the component of the local magnetization of the energy-selected element along the direction of light incidence. The principal benefits of this method are high magnetic sensitivity, uniquely combined with chemical specificity - both in a near-surface region of the sample [l]. Difficult but technologically important is the issue of pushing the lateral resolution. Compared to earlier experiments at bending magnets we achieved a significant enhancement well into the sub-micron range due to a higher source brightness and degree of polarization. An immediate effect in our microscope was the observability of "isolated" domain walls, i.e., walls separating domains of opposite magnetization, but normal orientation with respect to the incoming light. Two of these domains show up in the image with the same intermediate gray-level, but are now discernible by a bright or dark line, depending on the chirality of spin rotation within the wall. In figure 1 such walls (more pre-

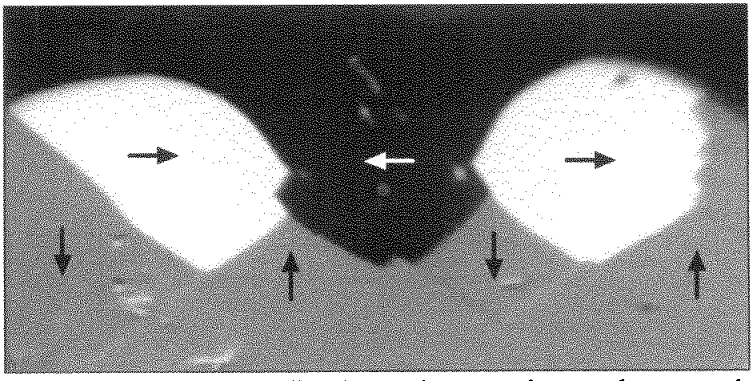

Figure 1: Domain walls on Fe(001)

cisely the so-called V-limes) can be seen in a rather complex pattern of three-dimensional closure domains which are formed on the clean (001) surface of an iron whisker that is under mechanical stress. Shown is the asymmetry of two images taken at the Fe L_3 edge with reversed helicities. Arrows indicate the direction of magnetization.

We have investigated the magnetic coupling of ultrathin Fe/Cr/Fe(00l) sandwiches with a wedge-shaped Cr spacer grown in-situ and at different preparation temperatures. Figure 2 shows as example the onset of a stepped Cr/Fe(00l) wedge in the sub-monolayer regime, which was grown at room-temperature. The height of each step is about 0.1 ML and its width 15 pm. Underlying and oriented normal to the step-edges is a 180" domain wall in the iron whisker. A change of the local Cr moments from antiferromagnetic to ferromagnetic coupling is noticeable at about l/3 ML coverage, although the maximum asymmetry in the Cr signal is only 0.6 %.

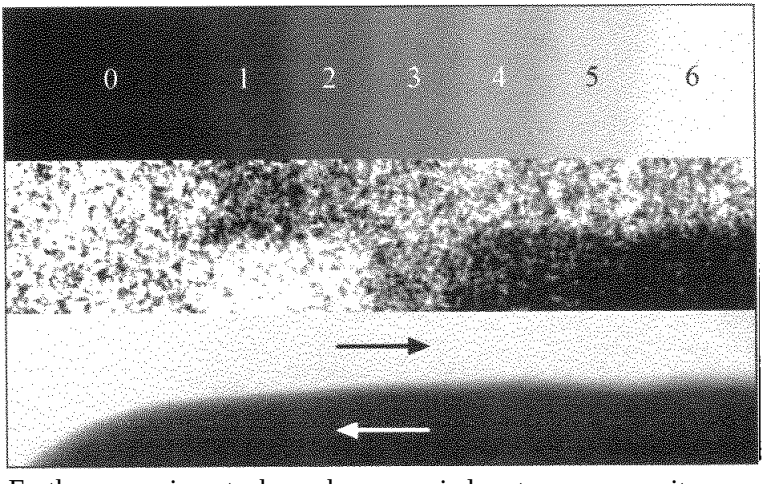

Figure 2: Cr wedge on Fe(001)

Image taken at the Cr L_3 edge, numbers count the steps – equal to coverage in 1/10 ML units

same area:
Dichroic asymmetry upon change of helicity at the Cr L_3 edge

same area:
Asymmetry upon change of helicity at the Fe L_3 edge, arrows indicate magnetization direction

Further experiments have been carried out on an ex-situ prepared polycrystalline sample of multilayered (Co/Pt)/Si, resolving its domain structure.

[l] W. Swiech, G.H. Fecher, Ch. Ziethen, 0. Schmidt, G. Schönhense, K. Grzelakowski, C.M. Schneider, R. Frömter, H.P. Oepen, and J. Kirschner, J. Electron Spectr. Rel. Phenom. (in print)