ESRF

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Report:

1/ Introduction

To understand the magnetic properties of Fe nanostructures deposited on Au(111) (see experimental report HE 558, HE653 and Ref. Ohresser *et al*., Phys. Rev. B. in press) a good knowledge of the structure is mandatory. We performed Grazing Incidence X-ray Diffraction (GIXD) on Fe films on the Au(111) reconstructed surface. 15 thicknesses were analysed, from 0 to 6 monolayers (ML). We paid a particular attention to the lower coverages (from 0 to 1 ML), where Fe clusters organize on the herringbone reconstruction of gold, which is the thickness range where we observed the most interesting magnetic phenomena. First, we observed the evolution of the reconstruction diffraction peaks, arising from the 22x√3, and those originating from the herringbone itself (see Fig. 1).

Second, the crystallographic structure is analysed in plane by HK-scans and out-of-plane by L scans. In particular, the transition from fcc to bcc is followed.

We maped the reciprocal space around a (0 1 0.12)-type truncation rod as a function of Fe coverage.

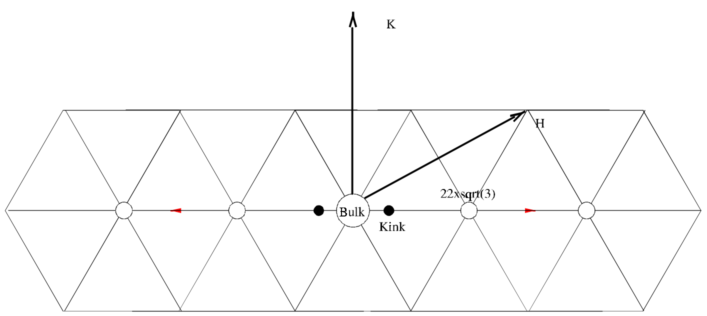

Fig.1 Reciprocal space of the Au(111) reconstructed surface. Large open circles: bulk in-plane periodicity. Small open circles: 22x√3 reconstruction. Small solid circles: herringbone reconstruction.

2/ Influence of Fe on the herringbone reconstruction of Au(111)

Figure 2 displays the evolution of the angular scan around the (0 1 0.12) truncation rod as a function of coverage. The peaks marked as 1 correspond to the 22x√3 reconstruction (first and second order), whereas peaks 2 correspond to the herringbone structure. The main effect of Fe deposition is to destroy the reconstruction peaks 1. At about 2 ML, the reconstruction peaks is canceled, but the peaks associated to the herringbone (peak 2), remain visible. The latters disappear at about 3 ML.

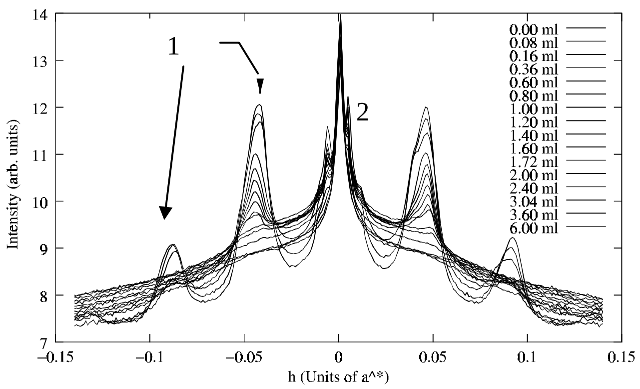

Fig.2 High resolution angular scan through the reconstruction peaks in the vicinity of the (0 1 0.12) truncation rod

2/ Crystallographic structure of Fe films

Figure 3 displays a mapping in the vicinity of the (0 1 0.12) truncation rod, for clean gold (a) and for 6 ML Fe (b). After the 6 ML deposition, the reconsruction peaks have disappeared, and two lateral spots have grown. These spots can be related to a multidomain bcc phase, either in the Nishiyama-Wassermann or Kurdjumov-Sachs orientation. A more precise analysis has yet to be performed.

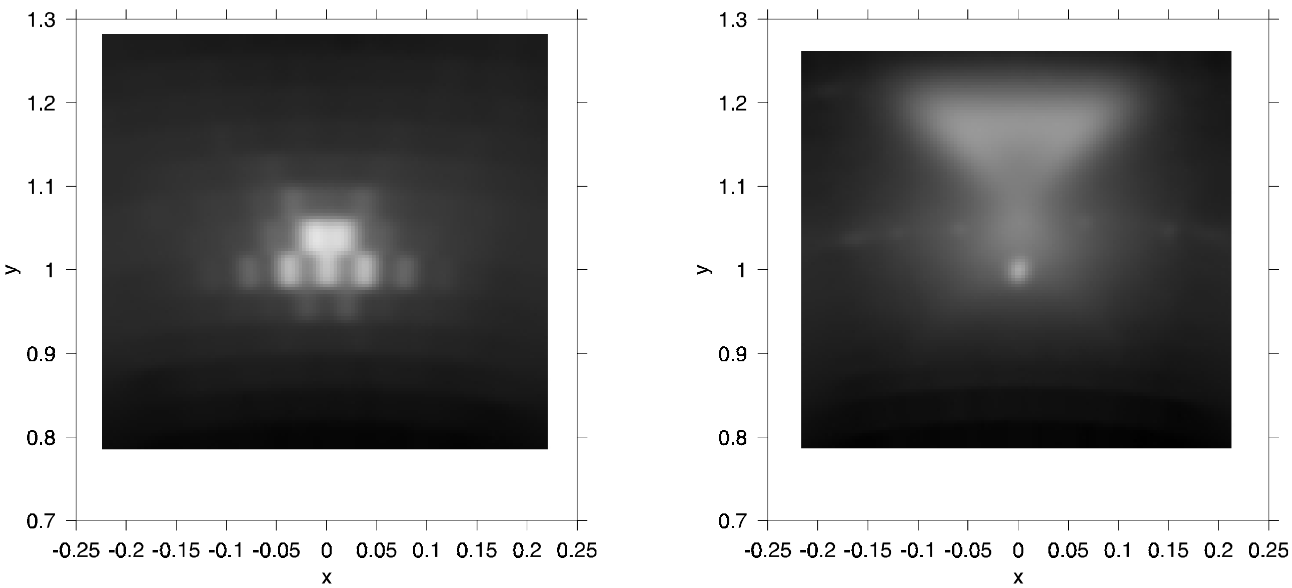

Fig.3 Mapping around (0 1 0.12) of clean Au(111) (a) and of 6ML Fe/Au(111) (b)

To obtain the in-plane parameters, in-plane scans were recorded. However, due to the peculiarity of the reconstructed gold surface, it is not possible to obtain in a simple way the lattice parameter of the Fe adsorbate. One has first to understand the intensity of the diffraction peaks of the bare gold surface through simulations (ROD simulation program, in progress). Therefore, we integrated the truncation rods in the three directions for several thicknesses for further analysis.