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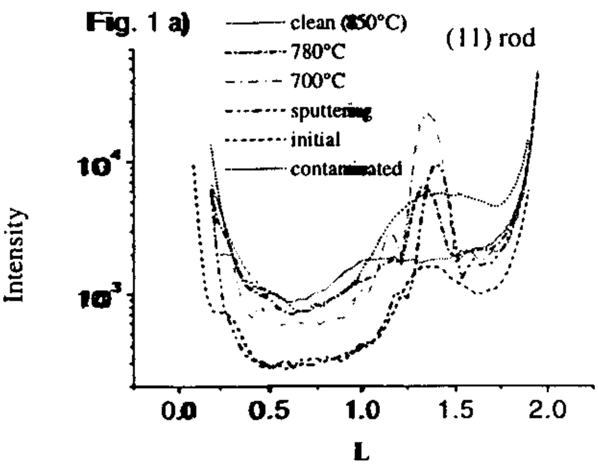
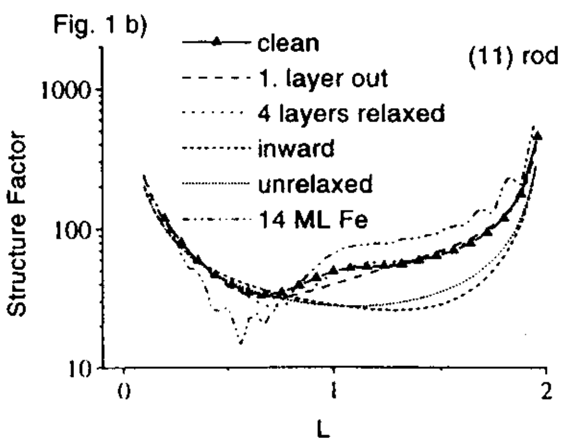
Report: The aim of our experiment was the correlation of structural properties of the Fe / Cr(100) interface with magnetic properties of the Cr(100) epitaxial film. In addition we wanted to look for outward surface relaxations which are predicted to be present on the Cr(100) surface. The epitaxial Cr(100) films were prepared by molecular beam epitaxy on a Nb(100) / r-sapphire buffer substrate system. During sample cleaning in the experimental chamber on ID3 the natural oxide layer had to be removed. Since the Auger spectroscopy system did not work (like on our first experiment in 97), the sample preparation was followed by surface x-ray diffraction. Fig. 1 a) shows CTR measurements after different preparation stages: the initial surface shows a characteristic peak that increases during sputtering and annealing to 700°C. An epitaxial oxide layer is formed, as seen from the interference fringes. At 780°C the decomposition of the oxide layer starts and at 850°C the peak at L=1.4 disappears, indicative for the removal of the oxide layer. The clean surface shows a modulation at L=1, which will be discussed later. If the surface is exposed to bad vacuum, the peak at L=1.4 reappears due to reaction with water. The curve 'contaminated' was taken after 1.5 days at 10^{-8} mbar in a separate prepchamber, and a re-growth of the oxide layer is observed. In Fig. 1 b) the structure factor along the (11) rod for different conditions together with model calculations is plotted. The intensity profile from the clean surface deviates clearly from the ideal profile of an unreconstructed Cr(100) surface as well as from an inward relaxed surface. An outward relaxation of the first layer of 10% reproduces the asymmetry of the experimental data and a relaxation of 4 layers can also reproduce





the modulation at L=1. After the deposition of 14 ML Fe at 450 K a modulation on the CTR is present due to the finite thickness of the commensurate Fe layer, which is superimposed onto the initial modulation at L=1. One possible reason for the strong modulation of the clean surface rod could be a magnetically induced outward relaxation of the first layers. To get more insight into the surface composition, in-house RBS measurements (H. Carstanjen, D. Plachke, MPI-MF Stuttgart) have been performed on the samples after Fe growth. The sample with a smooth Fe / Cr interface showed a Nb RBS peak corresponding to 0.7 ML Nb located at the Cr/Fe interface, produced presumably by Nb segregation during the high temperature oxide layer desorption. A Nb contamination of the surface could indeed explain the observed modulation on the CTRs since Nb has a 10% bigger atomic diameter than Cr.

After cleaning the surface, the spin density wave satellites of Cr were measured at 200 K around the (101) reflection. Fig. 2 shows the SDW satellites for 2 samples that differ slightly in the annealing time during oxide layer removal. Sample 1 shows in-plane and out-of-plane SDWs prior to Fe deposition (Figs. 2 a) and 2 b)), which is a more bulk-like behavior due to the strain relief after long annealing, whereas sample 2 exhibits only out-of-plane SDWs (Figs. 2 c) and 2 d)). After the deposition of 3 ML Fe only (substrate at 450 K) the in-plane SDW of sample 1 is completely suppressed and only the out-of-plane SDW survives. This is similar to sample 2, where also only an out-of-plane SDW is observed after Fe deposition. For both samples the distribution of SDWs is not changed for thicker Fe layers. This behavior is in agreement with the model of a ideal Fe / Cr interface, because in that case a transversal out-of-plane SDW would be expected, with Fe and Cr spins laying anti-ferromagnetically coupled in the surface plane. In the case of Cr films that have been covered with Fe directly after the Cr film deposition a different behavior was observed: the Fe layer induced in-plane SDWs, which were explained by strong spin frustrations at the Fe / Cr interface due to topological defects. The conclusion is that after the deposition of the Cr layer growth induced topological defects are present, like Cr islands etc., that are removed by the sample cleaning procedure before the experiment described here. The magnetic structure of the Cr layers is much stronger influenced by the microscopic topology of the Fe / Cr interface than was expected. The surface structure and relaxations of pure Cr and its correlation to the magnetism are still open fundamental problems which require a different preparation of the Cr film to avoid possible Nb contamination. A resubmission of the proposal is planned after final tests on the preparation.