**Experiment title:**
*Influence of interface structure on GMR and magnetic behaviour of Fe/Cr multilayers*

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<th>Beamline:</th>
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<td>from: 04.06.02 to: 08.06.02 and from: 29.08.02 to: 01.09.02</td>
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<th>Local contact(s):</th>
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<td>Dr. Norbert Schell</td>
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**Report:**

The *interface structure of Fe/Cr multilayers* (MLs) was studied by x-ray reflectometry (XRR) and diffuse scattering using the contrast enhancement between Fe and Cr for measurements at energies in vicinity of the K-edges of these elements. The Fe/Cr MLs, UU9_3, UU9_1 and UU9_4, having the double layer structure \(8 \times [^{57}\text{Fe}(2\text{ nm})/\text{Cr}(1\text{ nm})]\), were prepared by MBE on sapphire with a Cr buffer layer (7 nm) at different substrate temperatures of 60°C, 140°C and 240°C, respectively.

The data were received in the first run at energies *below* (5.95 keV) and *above* (6.05 keV) the **Cr K-edge** and in the second run *below* (7.10 keV) and *above* (7.15 keV) the **Fe K-edge**. Besides the measurements of the specular scattering also the diffuse scattering was studied by rocking and offset scans. Fig. 1 shows the plotted intensity of such scans taken at 7.10 keV.
This study is a part of measurements on a series of this type of MLs. The MLs were grown on (1 0 -1 2) Al$_2$O$_3$ substrates, covered by 7 nm–Cr buffer layer, at different substrate temperatures in the range 20–480°C. Preceding investigations [1] have shown that the interface rms-roughness in these Fe/Cr-MLs strongly depends on the substrate temperature.

At present the evaluation of the measurements is not completed. Simulations using the REFS code (Bede Scientific software package) [2] are done only for the sample UU9_1. However, first results concerning the specular reflectivity have shown:

- The interface rms-roughness, $\sigma_{\text{rms}}$, of Fe-on-Cr ($\sigma_{\text{rms}}^{\text{Cr}}$) and Cr-on-Fe ($\sigma_{\text{rms}}^{\text{Fe}}$) are significantly different. The interface width $\sigma_{\text{rms}}^{\text{Cr}}$ is smaller compared to interface width $\sigma_{\text{rms}}^{\text{Fe}}$.

From the distribution of the diffuse scattering of this ML follows:

- The part of the vertically correlated interface rms-roughness, $C_v$, does not exceed an amount of $C_v \approx (30 \pm 15)\%$.
- The MBE-grown Fe/Cr MLs of this type have an interface morphology with a short lateral roughness correlation length $\xi \approx 8\pm3$ nm.
- The Hurst parameter, $h$, indicates with values of $h \approx 0.35\pm0.5$ a relatively high jaggedness of the interfaces. Based on the model of a self-affine interface morphology [3], this gives a fractal dimension $D=3-h$ of appr. 2.65.

References