ESRF	**Experiment title:** Examination of magnetic surfaces by x-ray resonant scattering	Experiment number: HE-203
Beamline: ID20	**Date of experiment:** from: 2/12/97 to: 9/12//97	**Date of report** 2712198
Shifts: 18	Local contact(s): C. Vettier	*Received at ESRF:*

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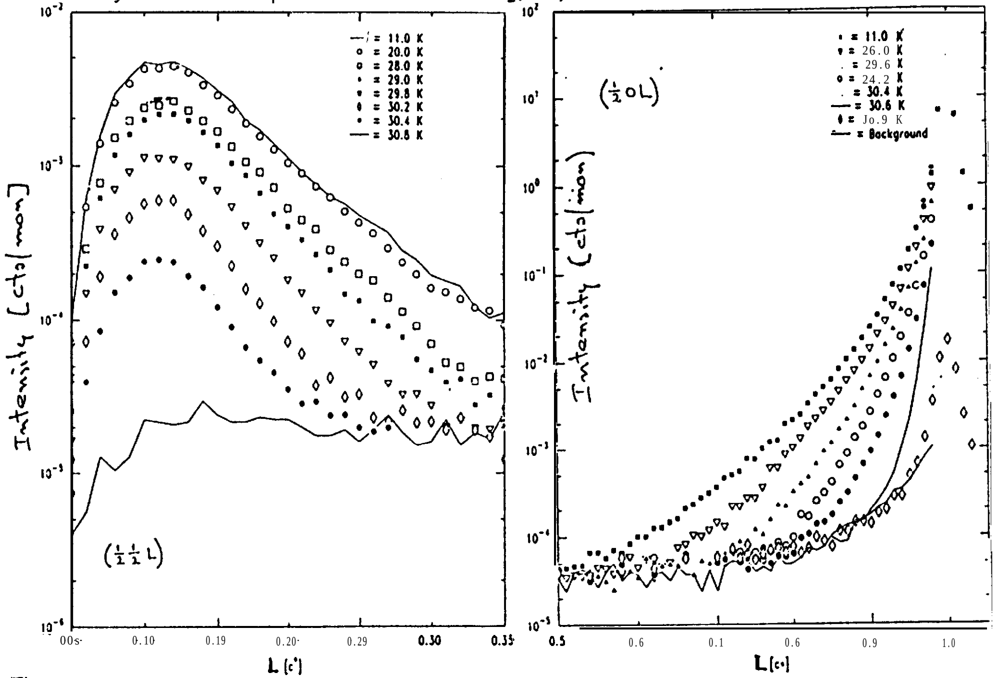
Report:

This was the first time that surface antiferromagnetic scattering had been attempted at ID20 and it was most successful. The crystal used was a highly polished UO_2(111) face. In previous experiments at NSLS we have reported [1] the observation of magnetic surface truncation rods (STR) from the UO_2(001), and measurements have been made of their temperature dependence. This information, in principle, gives a detailed description of the magnetic surface topology. As the sample is warmed towards T_N (~ 31 K) the question is whether phenomena associated with surface melting, as predicted by Lipowsky and collaborators [2], takes place. In the work on (001) surface the most striking result was that the order of the transition changed from discontinuous in the bulk to continuos at the surface. The other aspect that was found was that the interfacial region between the ordered bulk and surface layer increased rapidly near T_N. Some of these results agree with theory, but others do not.

Some of the data collected at the ID20 beamline with the (1 1 1) surface arc shown in the Fig. 1. As is usually the case when considering a (1 1 1) surface the Miller indices are transformed into a hexagonal set with the surface normal being (00L). The intensities in the left panel represent grazing incidence, so that the decrease as L→0 is a consequence of the beam being incident at the horizon of the crystal. The characteristic Vincysrd shapes as a function of the momentum transfer along the surface normal are shown as a function of T. There is a shape change as a function of T. This is perhaps easier to observe in the right panel which shows a STR measured around a "bulk" magnetic reflection actually at ~15° incidence to the surface. Thus the bulk magnetic Bragg peak is at L = 1 and we have been able to follow the truncation rod down to L = 0.55 c*. Notice how the scattering falls off faster with L at higher temperature. This is related to the increase in the interfacial region at T→T_N mentioned above. However, the experiments at ID20 also show that the transverse width of the scans, i.e. across the STR's, becomes wider as a function of L, even at the lowest temperature. The full-width at half maximum (FWHM) is shown as function of L in Fig. 2. This quantity was found independent of L from the UO_2(001) surface.

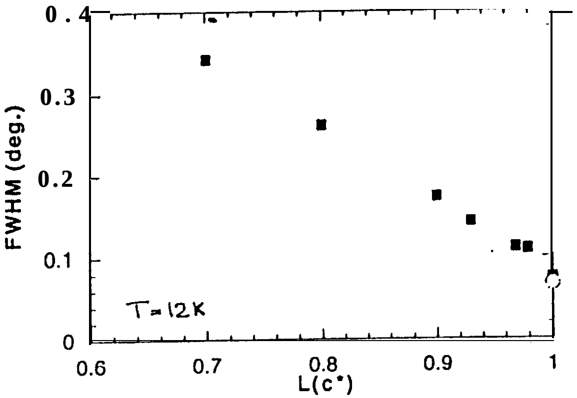


Figure

Intensity distribution along two surface truncation rods (STR) from the UO_2 (111) crystal face taken at various temperatures at ID20. In all cases an Au(111) analyser was used to improve the signal/noise ratio.

Figure

Analysis of the tranverse direction across the STR from the (1/2 0 L) reflection showing how the FWHM increases as one moves away from the Bragg peak (L=1). This shows roughness in the plane of the surface – a roughness that is not seen in the charge STR.



References:

[1] G. M. Watson et al., Phys. Rev. Letters 77, 751 (1996)

[2] R. Lipowsky, Phys. Rev. Letters 49, 1575 (1982); R. Lipowsky and W. Speth, Phys. Rev. B 28 3983 (1983)