| ESRF | **Experiment title:** Resonant x-ray scattering on $(U_{1-x}Np_x)Ru_2Si_2$ solid solutions | Experiment number: **HC-380** |
|---|---|---|
| **Beamline:** ID20 | **Date of experiment:** from: 24/6/97 to: 29/6/97 | **Date of report:** 13/8/97 |
| **Shifts:** 15 | **Local contact(s):** C. Vettier | *Received at ESRF:* 13 AOUT 1997 |

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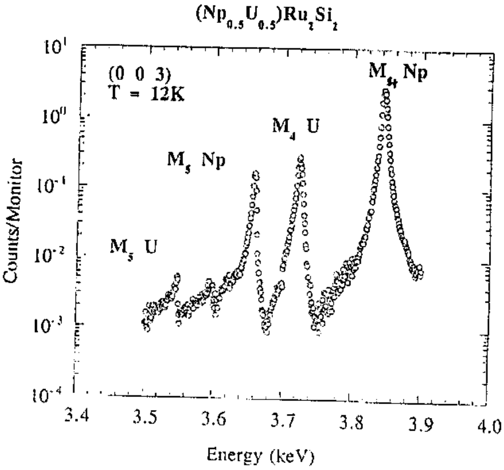
**Report:**

The present experiments represented the first performed on a transuranium sample at ID20, and, as far as we know, also at the ESRF. The idea behind these experiments was to use the high intensity of the resonant magnetic scattering process in the actinides together with the element specificity to examine solid solutions of the form $(U_{1-x}Np_x)Ru_2Si_2$. The small crystals, made by slow cooling the melts in Karlsruhe, were less than 1 mg in weight with a surface area of ~ 0.2 $mm^2$. Since they are encapsulated (in Karlsruhe) and cannot be viewed optically at ID20, we developed a new technique to "find" these crystals in the photon beam. This involved glueing the crystals on a 2 x 2 $mm^2$ Ge( 111) wafer and then scanning the incident beam across the Ge wafer while monitoring the Bragg intensity. In this way the positions of the crystals were indicated by their absorption of the Ge reflection. The Bragg reflections from the sample crystals were then found by the normal method. The procedure worked well, and would be capable of examining crystals at least 100 times smaller, i.e. in the μg range. We examined crystals of x=1.0 and x=0.5, which were actually glued on the same Ge wafer and this meant that two experiments could be performed without re-mounting samples. Because of the safety procedures the latter is rather cumbersome.

Perhaps the most striking data from this experiment is that from the x=0.5 sample in which an energy scan (Fig. 1) shows that magnetic moments reside on both the U and Np atoms. What we hope to deduce from these data is the relative moments on both sites (the moment is known from the Mössbauer experiments [l]) and the electronic state of both the Np and U ground states. In principle the latter may be deduced from the branching ratio, which is given by the amplitude of the $M_4$ resonance divided by that at the $M_5$ [2]. A further check on these calculations is that neutron experiments are also being conducted at the ILL to obtain the "average" moment.

Figure 1

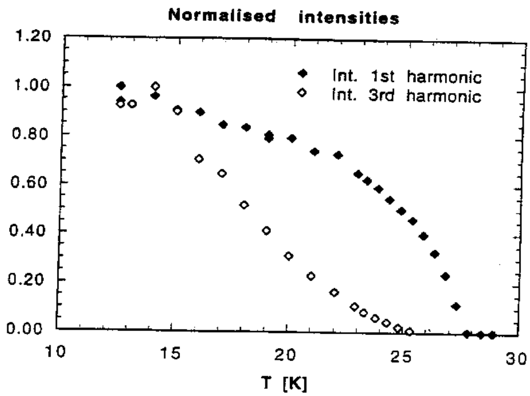
Energy dependence of the x-ray scattering intensity from the (003) magnetic reflection (at T= 12 K) from the sample with x=0.50. The positions of the $M_4$ and $M_5$ edges for U and Np are marked. These data were taken on ID20 at the ESRF in June 1997. The count rate at the Np $M_4$ peak was 0.7 x $10^6$ cts/s.




The x=1.0 sample is incommensurate and was already examined by neutrons some years ago [3]. We have been able to readily measure the magnetic wavevector, the coherence length of the modulation (related to the width of the magnetic satellite) and its intensity as a function of temperature.

Figure

We show the intensity as a function of temperature for the 1st. and 3rd-order satellites in the x=1.0 sample





References:

[1] S. Zwirner et al., Physica B 230-232,8O (1997)

[2] C. C. Tang et al., Physical Review B 46, 5287 (1992)

[3] M. Bogé et al., J. of Nuclear Materials 166, 77 (1989)