ESRF

Experiment title: High pressure measurements of the crystallographic structure of the heavy fermion superconductors UM_2Al_3 (M = Pd, Ni)

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Report:

UM_2Al_3 (M = Pd, Ni) are magnetically ordered heavy fermion superconductors [1,2]. The crucial parameter in determining the physical properties of these compounds is the hybridization strength between the f - electrons and the band states. By applying external pressure, the unit cell is compressed and the hybridization increases. Resistivity measurements of UPd_2Al_3 under pressure [3] showed a continious decrease of the Néel temperature due to Kondo compensation effects, whereas the superconducting transition temeprature T_c remained constant up to 65 kbar. Above this pressure, long range magnetic could not be detected anymore and T_c starts to decrease. Here we report on x - ray measurements at room temperature and under applied pressure to look for any structural relationship of its exciting physical properties. The experiments have been performed on the high pressure beam line ID09 at the ESRF. Carefully powdered polycrystalline samples were mounted in a diamond anvil cell providing pressure up to 400 kbar. Methanol - ethanol was used as pressure transmitting medium and ruby fluorescence as internal pressure standard. The doublet structure of the fluorescence line could be resolved up to the highest pressures available, thus indicating only small pressure gradients. This is due to the extremely small amount of sample loosely emersed in the pressure transmitting medium enabled by the high

flux of the ESRF. The recorded raw data were corrected and integrated employing theprogram The incident wavelength has been determined to $\lambda = 0.455$ Å by measuring a Si standard.

At ambient pressure, both compounds show the well known $PrNi_2A_3$ - type of structure [l]. In the case of UNi_2Al_3, the application of pressure merely compresses the unit cell. No change of its crystallographic structure could be detected up to p = 385 kbar. For UPd_2Al_3 a structural phase transition takes place at around $p \approx 230$ kbar into an up to now undetermined high pressure phase. To check this behaviour being an intrinsic property of the sample, we repeated the experiment with a second loading of the diamond anvil cell, yielding reproducible results and thus confirming the high pressure phase transition. The corresponding diffraction patterns are displayed in Fig. 1

The analysis of the data is under way. We are pleased by the good technical and scientific support at the ESRF enabling us to carry out these experiments in a very efficient manner.

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[1] A. Krimmel et al, Z. Phys. B 86, 161, (1992)

[2] P. Link et al, J. Phys. C 7, 373, (1995)

[3] A. Schrbder et al, Phys. Rev. Lett. 72, 136, (1994)

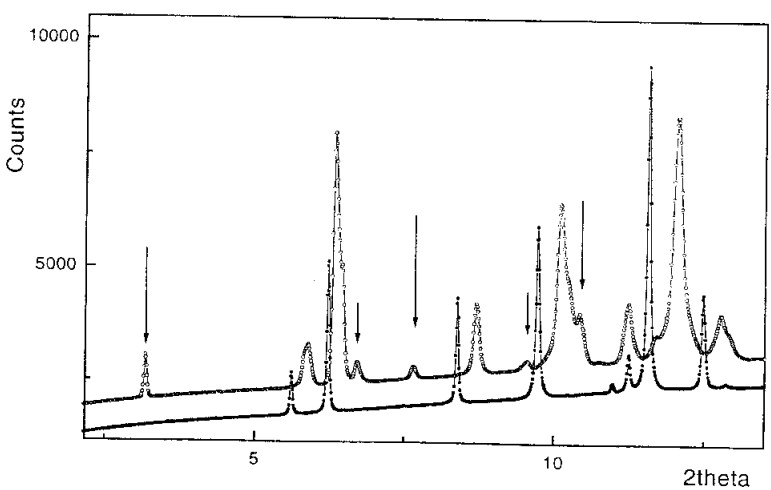

Fig. 1 Diffraction patterns of UPd_2Al_3 below (full circles) and above (open circles) the structural phase transition at $p \approx 250$ kbar. Arrows indicate additional reflections of the high pressure phase.