ESRF	**Experiment title:** High-pressure XMCD investigation of the 5f states in UGa2	**Experiment number**: **HC- 1491**
Beamline: ID12	**Date of experiment**: from: 12/11/2014 to: 18/11/2014	**Date of report**: 08/12/2014
Shifts: 18	**Local contact(s)**: WILHELM Fabrice	*Received at ESRF:*

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Report:

The original objective of the proposal, namely the high-pressure XMCD study of the 5*f* states of uranium in UGa_2 in the range of 8-15 GPa could not be achieved in this experiment. The main reason was inability of the the pressure cell provided at the ID12 beamline to reach the declared pressure of 7-8 GPa, the cell broke at 5 GPa. Also at the beginning of the HC-1491 run the diamond window and the anvils of the cell had been broken after the previous experiment and their replacement consumed 2 days of the measuring time. During the HC-1491 run itself the diamond window and anvils broke for the second time and it became apparent that the existing cell design is not suitable for the measurement described in the proposal.

The HC-1491 run has provided the room-temperature XANES spectra at the M4 and M5 edges of uranium at pressures p = 1.7 GPa, 3.1 GPa, and 5.3 GPa. In addition, ambient pressure XMCD data were collected at T = 30 K and $\mu_0 H$ = 1 T. In both cases the samples were 20 mkm single-crystalline plates cut and polished from the same single crystal. During the measurement the easy-magnetization <100> plane of the plates was oriented perpendicularly to the beam direction. The high-pressure measurements have been perfomed using the He-filled diamond anvill cell with a 50 mkm perforated diamond window. The perforation was used in order to reduce the absorption in the energy range of the M4 and M5 edges of U, which is 3-4 keV. The XMCD data were collected on the sample mounted on the holder outside the pressure cell.

The room-temperature XANES spectra of UGa_2 are represented by the fluorescensce yield in Figures 1 and 2. The application of pressure up to 5 GPa leads only to minor changes in the peak hight and almost no energy shift of both lines indicating that the 5*f* stated are practically unaffected. This result agrees with the assumption that the magnetic moment of uranium in UGa_2 starts to be affected only around p = 8 GPa.or higher.

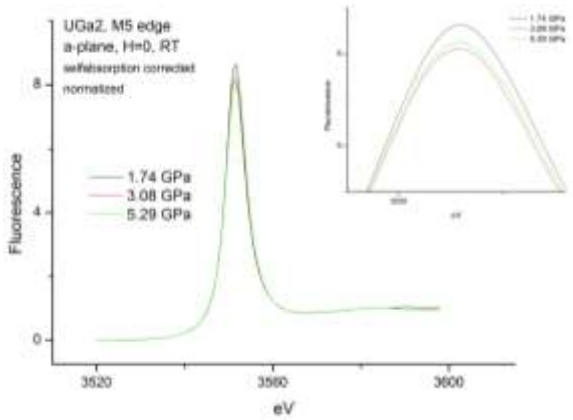

Fig. 1. Fluorescence data for the M5 edge of uranium in UGa_2 at various pressures.

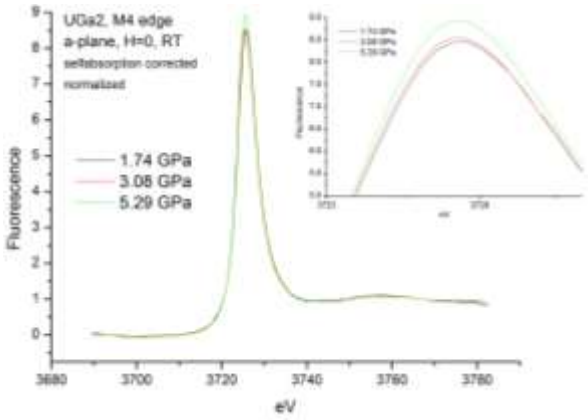

Fig. 2. Fluorescence data for the M4 edge of uranium in UGa_2 at various pressures

The XMCD M4 edge exhibits two spectral features (Fig. 3) indicating that the 5*f*-states of uranium may be in two different states. The data obtained earlier for the bulk UGa_2 sample have no such feature.

We had performed the EDX surface analysis of one of the plates prepared for the experiment and observed no oxidation traces on the surface of the sample. The average stoichiometry was the correct one (UGa_2) with no substantial inhomogeneity in the atomic distribution.

Hence, we consider that the observed double-peak M4 line of uranium is due to the surface effects – amorphisation or residual stress – induced in the process of polishing.

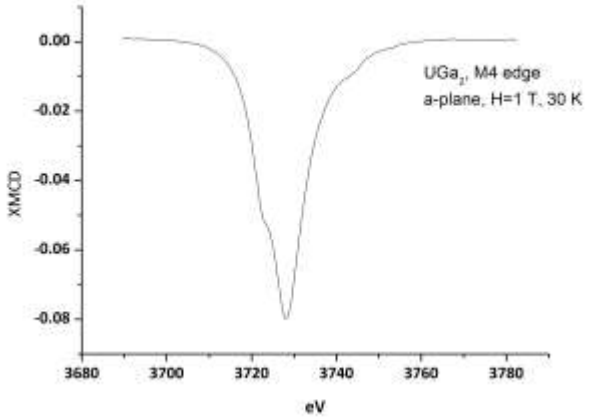

Fig. 3. XMCD on the M4 edge of uranium in UGa_2 at the ambient pressure

We intend to resubmit the proposal considering the sceintific value of the experiment and since, to our knowledge, the new pressure cell capable of withstanding higher pressure would be developed at the ID 12. Also we consider using different sample preparation techniques.