



Experiment title:

Phase diagram of americium metal under high pressure and temperature

Experiment number:

HS 2334

Beamline:

ID30

Date of experiment:

from: 09/06/2004 at 8:00 to: 15/06/2004 at 8:00

Date of report:

17/10/2004

Shifts:

9 + 9

Local contact(s):

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Received at ESRF:

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Report:

Samples of ²⁴³Am were synthesised at the ORNL in the USA and shipped to the CEA-Valduc where they were loaded into electrically heated diamond anvil cells (DACs) with argon used as the pressure transmitting medium and ruby and samarium as pressure gauges. The DACs were mounted in specially designed containers for shipment to the ESRF and the experiments at ID30. A (61.3 keV, 40x40 μm²) high energy collimated x-ray beam was used in order to compensate for the limited (around 10°(2θ)) opening angle of the DAC. Exposure times were around 300 seconds using the Mar 345 image plate detector.

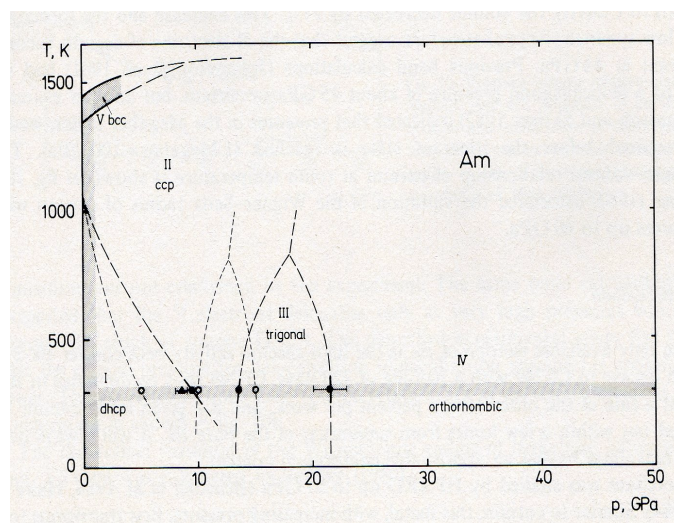
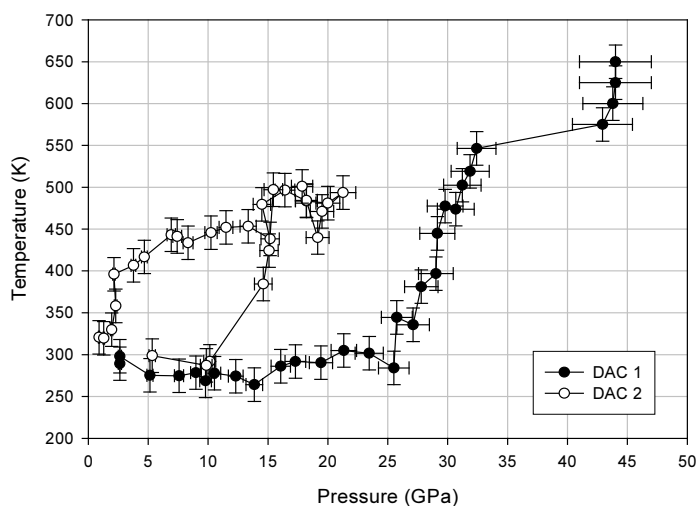


Figure 1 (a) : thermodynamic paths for the two DACs. (b) : Proposed diagram (ref [1])

The initial structure of the americium used in our experiments was the standard dhcp form. Further analysis of our data (fig. 1(a)) will determine the precise P-T phase diagram of Am for 300 K to 650 K, and pressure up to 45 GPa. In addition to the four phases previously determined for Am from experimental data obtained on the ID30 beam line [2] we also observed a re-crystallisation at 19 GPa and 480 K, which appears to correspond to a triple point proposed by Benedict [1] (see fig. 1 (b)).

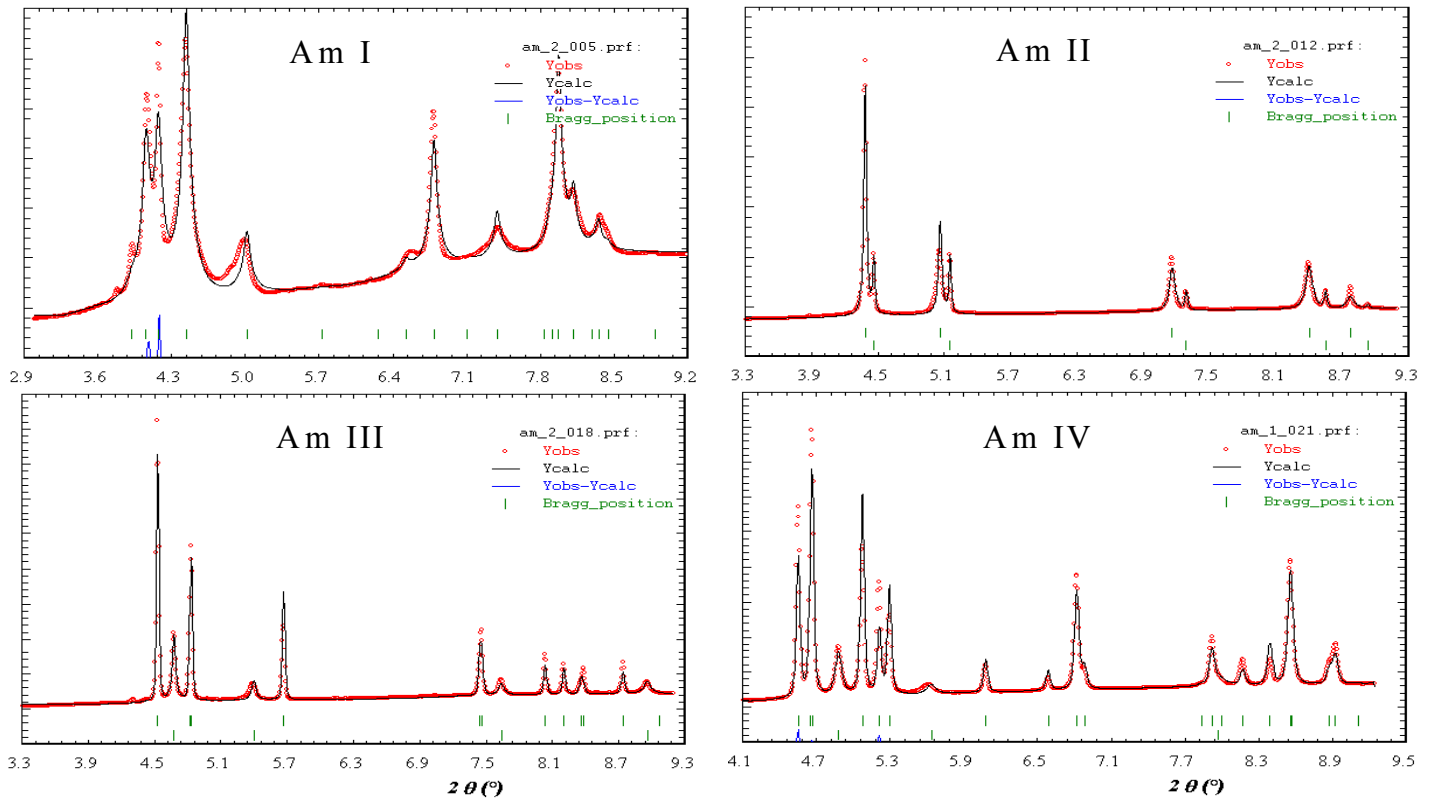


Figure 2 : Raw Rietveld refinements of the four known phases of Americium.

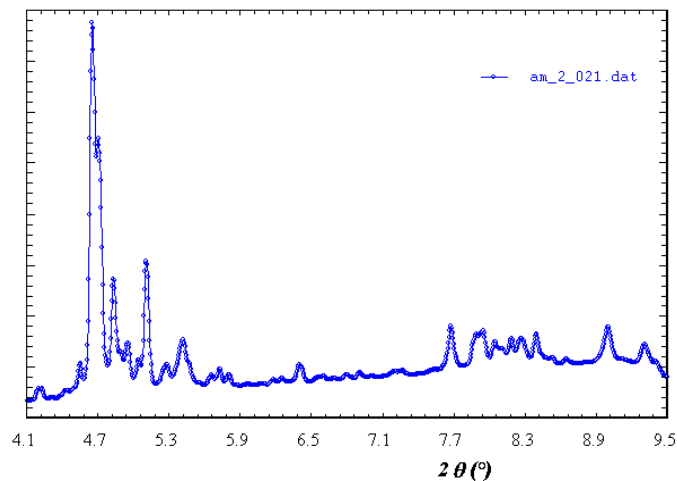


Figure 3 : Diffraction spectrum of the unknown phase, obtained at 19.5 GPa and 471 K.

In conclusion, this international collaboration was successful and provided high-quality data for the first T-P structures of Am, which can now be compared with theoretical predictions. Additional T-P experiments, complementary to this one, either on Am and/or other actinide metals or alloys are being planned for future proposals for studies on the new ID27 beam line.

- [1] U. Benedict, Handbook on the Physics and Chemistry of the Actinides, 227-269, edited by A. J. Freeman and G. H. Lander – Elsevier Science Publishers (1987)
 [2] S. Heathman, R. G. Haire, T. Le Bihan, A. Lindbaum, K. Litfin, Y. Méresse and H. Libotte, Phys. Rev. Lett. 85, 2961 (2000)