Experimental report

17/02/2016

Proposal: 4-01-1220 **Council:** 4/2012

Title: CEF scheme investigation of newly synthesized Ce2PtIn8

Research area: Physics

This proposal is a new proposal

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Samples: Ce2PtIn8

Instrument	Requested days	Allocated days	From	To
IN4	4	2	04/10/2012	05/10/2012
			05/03/2013	09/03/2013

Abstract:

Due to the tunable interplay between magnetism and superconductivity the CenTmIn3n+2m (n, m = 1, 2; T = Co, Ir, Rh, Pd, Pt) family of heavy fermion compounds has been attractive for thorough studies of the two cooperative phenomena. We have successfully prepared Ce2PtIn8 - a new phase from this family. Ce2PtIn8 single crystals were grown out of indium flux. Specific heat, electrical resistivity and magnetization measurements revealed that Ce2PtIn8 orders antiferromagnetically below 2.1 K. A second magnetic transition is observed just below at 2 K. The aim of the proposed experiment is to reveal the scheme of the crystalline electric field (CEF), which is very important for the heavy fermion ground states in these materials.

Experimental report- proposal 4-01-1220:

CEF scheme investigation of newly synthesized Ce_2PtIn_8

Main proposer: Petr CERMAK

Co-proposer(s): Pavel JAVORSKY, Marie KRATOCHVILOVA

Allocated days: 2

More than one decade the $Ce_nT_mIn_{3n+2m}$ (n = 1, 2; m = 1; T = transition metal) type compounds are subject of intense interest due to the interplay between magnetic order and superconductivity [1]. Crystalline-electric-field (CEF) effects are important for the heavy fermion ground states in these materials. It has been argued that the symmetry of the ground-state CEF doublet in these materials may be directly relevant to the f–conduction electron hybridization and in some cases may produce spin fluctuations which are more favorable for the formation of the superconducting condensate [2]. We have successfully synthesized a new phase Ce_2PtIn_8 from the In flux. According to the single crystal x-ray diffraction, the compound crystallizes in the tetragonal Ho_2CoGa_8-structure type with unit cell parameters a = 4.6994(5) Å and c = 12.1854(13) Å [3].

With respect to the fact, that the attempts to prepare polycrystalline Ce_2PtIn_8 were unsuccessful, the single crystals of Ce_2PtIn_8 selected from several batches (the crystals are very small ~ 1 mg) were grinded into a fine powder to be measured on IN4. In total, we prepared 1.72g of Ce_2PtIn_8 powder and 1.66g of La_2PtIn_8 powder.

The biggest challenge in the experiment was to deal with the significant absorption of the sample. We reduced the thickness to 0.4mm using the special aluminium holder. At this thickness, the absorption of the neutron flux was 91.3% and 83.7% for the Ce and La compound, respectively .

We have measured with λ = 1.2, 1.11 and 2.22 Åincoming wavelength. We have done careful analysis of the data including the meauserement of theempty aluminium holder and vanadium for energy calibration. After subtraction of the Lanthanum from the Cerium signal, there was no additional signal above the background.

Therefore, we need to claim, that experiment was not successful. The possible reasons could be:

1) High absorption of the sample due to Indium.
2) Very low cerium magnetic moment.
3) The low quality of the prepared samples (possible existence of a spurious phase Ce_3PtIn_{11} with very similar stoichiometry).

References

[1] J. D. Thompson *et al.*, J. Magn. Magn. Mater. 226-230 (2001) 5.

[2] E. D. Bauer *et al.*, Phys. Rev. Lett. 93 (2004) 147005.

[3] M. Kratochvilova *et al.*, J.Cryst. Growth 397 (2014) 47-52.