Strong electronic correlations in single crystalline $CePt_4In$

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Cubic $CePt_4In$ compound was originally classified in the literature as a valence fluctuation system with strongly enlarged electronic contribution to the specific heat (at 100 mK $C/T \approx 1.75$ J/(mol K^2)) and distinct crystal field effect [1]. That interesting (and physically questionable) coexistence of opposing ground states motivated us to undertake comprehensive investigations of the physical properties of this compound, performed in wide temperature and magnetic field ranges, using single-crystalline specimens. In the present contribution we summarize and discuss up-to-date results of magnetic-susceptibility, specific heat and Seebeck-coefficient measurements, carried out on single crystals, as well as the data of X-ray absorption at the Ce-L_{III} threshold (XANES), obtained from powdered polycrystalline samples.

As we reported in Ref. 2, temperature dependencies of the magnetic susceptibility and thermoelectric power are characteristic of systems with well localized magnetic moments. In particular, the anomalous magnetic properties of single-crystalline $CePt_4In$ can be interpreted in terms of a crystalline–electric–field model. The experimental data can be properly described by the Van Vleck-like formula, adapted either for the doublet–quartet or quartet–doublet schemes with the crystal field splitting Δ of the order of 260–320 K. A similar size of Δ was estimated from the peak position in the temperature dependence of the Seebeck coefficient. The rather stable $4f^1$ configuration of the Ce ions in $CePt_4In$ has been supported by measuring the XANES spectra at several different temperatures. All the $I(E)$ curves exhibit almost identical shape, which is dominated by $4f^1d^0$ and $4f^1d^1$ contributions, while the $4f^0$ configuration remains hardly visible at least down to 5 K.

The electronic specific heat ratio $\Delta C/T$ measured for $CePt_4In$ in zero magnetic field strongly increases with decreasing temperature down to about 250 mK, where a broad maximum (≈ 1.8 J/(mol K^2)) occurs [3]. At lower temperatures $\Delta C/T$ slightly diminishes and finally saturates at a value of about 1.75 J/(mol K^2). Upon applying magnetic field the maximum in $\Delta C/T\,(T)$ disappears (it is not visible already in 0.5 T) and the magnitude of $\Delta C/T$ becomes significantly lower. We argue that the observed anomaly in $\Delta C/T\,(T)$ is due to some sort of magnetic ordering of the cerium magnetic moments, in line with our statement on the localized character of the 4*f*-electrons in this compound.

[1] S.K. Malik *et al.*, Phys. Rev. B **40** (1989) R9378
[2] A.P. Pikul *et al.*, Phys. Rev. B **73** (2006) 092406
[3] A.P. Pikul *et al.*, to be published in "Proceedings of the International Conference on Strongly Correlated Electron Systems, May 13–18, 2007, Houston, USA"

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