МАГНЕТИЗМ

The study of heat capacity of Laves phase $NdRh_2$

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Rare-earth (RE) transition metal (TM) compounds $RETM_2$ with a C15 cubic crystal structure ($MgCu_2$-type, sp. gr. *Fd*-3*m*, No. 227) have long-lasting history of investigation. These materials represent almost ideal model systems, due to their simple chemical composition, crystal structure and ease of production. The members of $RETM_2$ family also display a plethora of physical properties, including superconductivity, unusual magnetism, hydrogen absorption, as well as a giant magnetoresistance and substantial magnetocaloric effects [1–3], etc.

In current work we study zero-field heat capacity $C(T)$ of recently synthesized Laves phase $NdRh_2$. This object was successfully obtained using a toroid high-pressure cell under both high pressure (P = 8 GPa) and temperature (T = 1500−1700 K) conditions. Experiment has been performed on PPMS-9 setup at temperatures 2−300 K. The high quality of the sample and its chemical composition was controlled by X-ray methods as well as by additional measurements of magnetization, electron-spin resonance and charge transport characteristics [3].

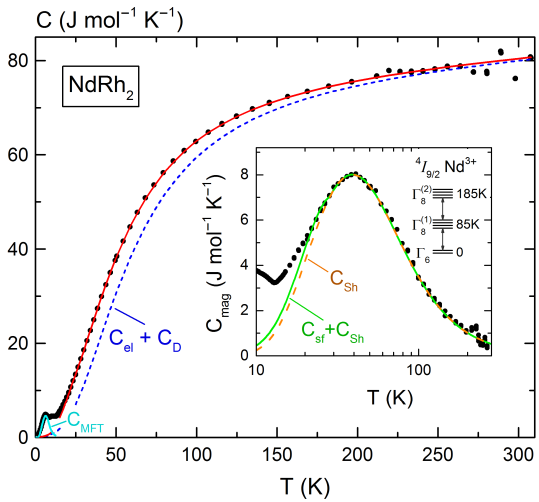

Fig. 1. Temperature evolution of zero-field heat capacity $C(T)$ of $NdRh_2$

The heat capacity was analyzed by original procedure, which takes into account along with electronic (γ_0 = 25 mJ/mol K^2) and phononic [ω_D = 20.9 meV] contributions additional Schottky component (C_{Sh}), caused by crystalline-electric-field effect, (see the main panel and the inset of Fig. 1 and also [3]). It was established that Schottky anomaly emerges in paramagnetic state of $NdRh_2$ with the ground state of the multiplet $^4I_{9/2}$ (Nd^{3+}) as a Γ_6 doublet. The excited states were fixed according to the splitting scheme depicted in the inset of Fig.1. The Schottky component was corrected by introduction of additional term resulting from the presence of spin-fluctuations [$C_{sf} = f(\theta_{sf})$] in the system. The spin-fluctuation temperature was estimated as $\theta_{sf} \approx 28.5$ K. At low temperatures, where all above components may be neglected, a double-peak structure appears on experimental data, Fig.1. Among of them the first anomaly at T_1 = 6.3 K may be associated with the ferromagnetic transition of Nd magnetic subsystem. It was approximated by using mean-field theory (C_{MFT}), Fig.1. The satellite maximum at T_2 = 10.8 K also has magnetic nature. It was shown that in the range 8–50 K, magnetic properties of $NdRh_2$ are determined by the ferrimagnetic Nd–Rh interaction, resulting in magnetic inhomogeneity and spin fluctuations. Details about the analysis are presented in [3].

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References

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