High-pressure influence on magnetic transitions of Ce$_2$Pd$_2$In intermetallic compound

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The physics of rare-earth element-based intermetallics is mainly determined by highly correlated 4f-electrons. In some compounds usually localized 4f-electrons states can hybridize with the wave functions of neighbouring atoms. The unique way how to directly affect the interatomic distances and thus the hybridization is application of external pressure.

In our study we have focused on the cerium-based compound Ce$_2$Pd$_2$In, which is known to crystallize in the Mo$_2$FeB$_2$-type structure (space group $P 4/m b m$), in the Shastry Sutherland lattice consisting of planes formed by Ce-atoms alternated by non-magnetic planes containing other elements. It belongs to the group of Ce$_2$T$_2$In compounds exhibiting, depending on the d-stoichiometry and magnetic propagation vector $k=(0.22, 0, 0)$, the accurate stoichiometry leads to presence of two magnetic transitions, the compound reaches ordered ferromagnetic ground state through the intermediate antiferromagnetic state [3,4,5].

The magnetic ground state of this compound is very sensitive to the off-stoichiometry. The excess of Ce leads to ferromagnetic ground state, while the excess of Pd results in incommensurate antiferromagnetism with propagation vector $k=(0.22, 0, 0)$. The accurate stoichiometry leads to presence of two magnetic transitions, the compound reaches ordered ferromagnetic ground state through the intermediate antiferromagnetic state [3,4,5].

We present the results of electrical resistivity and magnetic AC susceptibility measurements performed on a high quality Ce$_2$Pd$_2$In single crystal. A double-layer cylindrical pressure cell (made of CuBe and NiCrAl alloy) with nominal pressure range up to 3GPa was used. The sample was oriented along the tetragonal c-axis with respect to both - the electrical current and the magnetic field. Sensitivity to the applied external magnetic field was estimated. The $p$-$T$ phase diagram (Figure 1) shows evolution of the characteristic temperatures of both ferromagnetic ($T_C$) and antiferromagnetic ($T_N$) phase transitions in dependence on applied hydrostatic pressure. The external pressure affects both observed transitions. While a slight pressure-induced shift of $T_N$ to higher temperatures is observed, AFM phase remains to significantly lower temperature under applied pressure. Extension of the experiment to higher pressure range is needed to estimate total suppression of the FM phase.

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