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Magnetic and physical properties of the Shastry-Sutherland compound Pr2Pd2In

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The class of R2T2X intermetallics (R = rare earth, T = transition metal, X = main group) have a geometrically frustrated R-lattice which forms layers arranged in a Shastry-Sutherland lattice. In addition, due to the basic triangular motif in the frustrated structure, stabilization of different nearest-neighbor J values leads to complex low-temperature magnetic behavior. In this work, we have synthesized the Pr2Pd2In compound by arc-melting technique. The powder X-ray diffraction spectrum with a full-profile refinement confirms that Pr2Pd2In crystallizes in the layered Mo2B2Fe-type tetragonal structure, where planes of R = Pr ions lie on a triangular network. Dc-magnetic susceptibility shows that the Pr ions are in the magnetic trivalent state. Field-dependent magnetization shows metamagnetic behavior in the compound with the critical field of 1.5 T at 2 K. The antiferromagnetic order is unstable in applied magnetic fields, becoming ferromagnetic beyond a field value of 1.5 T. The magnetic entropy from our heat capacity studies revealed that the magnetic ground state is a well-isolated doublet. The electronic heat capacity coefficient value estimated from C4f data indicated that the compound belongs to the heavy-fermion family. The variety of magnetic properties such as para- ferro- and antiferromagnetic behavior including metamagnetic transition is observed due to the magnetic frustration from distorted triangles of Pr-atoms in Pr2Pd2In. This study may contribute towards a better understanding of the physics in Shastry-Sutherland structure compounds since in a frustrated lattice system such as this there are strict constraints imposed upon the magnetic order parameter.

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Yes

Level for award;(Hons, MSc, PhD, N/A)?

PhD

Primary authors: DJOUMESSI FOBASSO, Redrisse (Highly Correlated Matter Research Group, Physics Department, University of Johannesburg); Dr SAHU, Baidyanath (Highly Correlated Matter Research Group, Physics Department, University of Johannesburg); Prof. STRYDOM, Andre M. (Highly Correlated Matter Research Group, Physics Department, University of Johannesburg)

Presenter: DJOUMESSI FOBASSO, Redrisse (Highly Correlated Matter Research Group, Physics Department, University of Johannesburg)

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