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Crystal structure and thermodynamic properties of the non-centrosymmetric PrRu₄Sn₆ caged compound

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PrRu₄Sn₆ is a tetragonal, non-centrosymmetric structure compound [1]. It is isostructural to the extensively studied Kondo insulator CeRu₄Sn₆ [2, 3, 4] which crystallizes in the YRu₄Sn₆-type structure with space group I-42m. In this structure, the Pr atom fills the void formed by the octahedral Ru₄Sn₆ units which results in a tetragonal body centered arrangement [1, 5]. Here we present the physical and magnetic properties of PrRu₄Sn₆. The specific heat, C_p(T), electrical resistivity, &rho(T) and magnetic susceptibility, &chi(T) results collected between 300 K and 2 K do not show any phase transition in the temperature range. &chi(T) follows Curie-Weiss behavior above 100 K with effective magnetic moment, &mu_{eff} = 3.34 &mu_B/Pr which is close to the expected free ion value of 3.58 &mu_B/Pr and paramagnetic Weiss temperature, &theta_p = −19.47 K indicating a dominant antiferromagnetic interaction. The magnetization, M(H) at 2 K is quasi-linear in nature and attains a value of 0.86 &mu_B/Pr at 7 T which is well reduced compared to the free ion saturation moment of 3.32 &mu_B/Pr possibly due to magnetocrystalline anisotropy in the polycrystalline sample. The low-temperature analysis of C_p(T) gives a Sommerfeld coefficient, &gamma = 38.60 mJ/(K² mol). &rho(T) follows a typical metallic behavior down to low-temperatures in contrast to the semimetallic behavior observed in CeRu₄Sn₆. The thermal conductivity, &kappa of PrRu₄Sn₆ shows a glassy behavior above 30 K possibly due to the interactions of the low-frequency “rattling” vibrations of the guest atom with the acoustic phonons of the host lattice resulting in heat dissipation.

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