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Magnetic and physical properties of new hexagonal PrPt_4X ($\text{X} = \text{Ag}, \text{Au}$) compounds

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We have synthesized PrPt_4Ag and PrPt_4Au compounds for the first time and report their crystal structure, as well as magnetic and physical properties in the temperature range between 2 K and 300 K. Both compounds are derived from the substitution of Pt with Ag and Au respectively in the parent compound PrPt_5 which crystallizes in the hexagonal CaCu_5 -type structure [1, 2]. Here, we observed the preservation of the hexagonal CaCu_5 -type structure under such substitutions which is in contrast to the observations in PrCu_4Ag and PrCu_4Au [3, 4] adopting the cubic MgCu_4Sn -type structure upon substitution on parent hexagonal PrCu_5 . The temperature dependence of specific heat, $C_p(T)$ and electrical resistivity, $\rho(T)$ of PrPt_4Ag show an anomaly at 7.6 K but which is absent in the magnetic susceptibility, $\chi(T)$ and thus suggesting a possible multipolar ordering of the Pr^{3+} magnetic moment. PrPt_4Au on the other hand does not show any anomaly but an upturn in $C_p(T)/T$ below about 10 K and reaching a value of $1.23 \text{ J}/(\text{K}^2\text{mol})$ at 2 K. In addition, $\rho(T) \sim T$ and $\chi(T) \sim T^{-1/3}$ for nearly a decade in temperature. These observations in PrPt_4Au are the hallmark of a non-Fermi liquid (nFL) behavior and is characteristic of a system with a low lying order parameter. The analysis of the low temperature $C_p(T)$ for PrPt_4Ag and PrPt_4Au give values of the Sommerfeld coefficient, $\gamma = 728.5 \text{ mJ}/(\text{K}^2\text{mol})$ and $509.1 \text{ mJ}/(\text{K}^2\text{mol})$ respectively indicating a significant enhancement of the quasiparticle mass in the two compounds.

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Prof. AM Strydom, University of Johannesburg, amstrydom@uj.ac.za

Primary authors: Prof. STRYDOM, Andre (University of Johannesburg); Mr OGUNBUNMI, Michael (University of Johannesburg)

Presenter: Mr OGUNBUNMI, Michael (University of Johannesburg)

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