Transport and magnetic properties of $Y_{1-x}Pr_xCo_2$ compounds

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Pseudo-binary $Y_{1-x}R_xCo_2$ ($R=$ rare earths) compounds belong to the $RCO_2$ family with a cubic Laves phase MgCu$_2$-type structure. Curie temperature $T_C$ of the $Y_{1-x}R_xCo_2$ system decreases with decreasing of magnetic $R$ content $x$, and vanishes at a critical composition $x = x_c$. Anomalous behaviors of low-temperature electrical resistivity $\rho$ and thermopower $S$ of $Y_{1-x}R_xCo_2$ system with heavy rare earths have been observed, in particular: (i) residual resistivity $\rho_0$ is strongly enhanced on approaching to $x_c$, and (ii) magnetoresistance (MR) is large positive value in magnetic ordering region of $x \gtrsim x_c$. It has been found that these anomalous behaviors in heavy rare earth based alloys are connected with a non-uniform magnetization of the Co subsystem induced by spatial fluctuating exchange field owing to structural disorder of R subsystem [1].

In order to clarify the magnetic and transport properties in light rare earth based alloys, the measurements of $\rho$ and $S$ of the $Y_{1-x}Pr_xCo_2$ system have been performed at temperatures from 2 K to 300 K in magnetic fields up to 10 T. PrCo$_2$ is ferromagnet with $T_C = 39$ K. As shown in Fig. 1, $T_C$ decreases with decreasing Pr content $x$, and vanishes at $x \approx x_c$. And, $\rho_0$ takes a maximum at $x \approx x_c$, which is almost the same behavior as that of the heavy rare earth systems. MR of the $Y_{1-x}Pr_xCo_2$ system is negative in the whole range of $x$, except $x = 0.0$ and 1.0, which is contradict to the theoretical prediction. It is expected that MR is positive in $x \lesssim x_c$, and negative in $x \gtrsim x_c$. The Curie temperature $T_C$ of $Y_{1-x}Pr_xCo_2$ decreases with increasing pressure $P$, whereas $\rho_0$ increases with increasing $P$. These behaviors are similar to that of the heavy rare earth compounds.


Figure 1: Composition $x$ dependence of $T_C$ and $\rho_0$ of $Y_{1-x}Pr_xCo_2$. 