Which interaction establishes ferromagnetism in $Ce_x(La/Y)_{1-x}Pt$?

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In order to study Kondo ferromagnetism, we have investigated the $Ce_xLa_{1-x}Pt$, and $Ce_xY_{1-x}Pt$ alloy systems in the temperature range from 1.8 K to 320 K. While $Ce_xY_{1-x}Pt$ show considerable hybridization and, therewith, Kondo effect, in $Ce_xLa_{1-x}Pt$ hybridization very weak. By the resistivity measurements, we determined the energetic specter of the 4f level of the Ce^{3+} ion split by the crystal electrical field (CEF): a doublet and a quasiquartet at 120 K. The magnetic contribution to the resistivity, ρ_{mag}, of $Ce_xLa_{1-x}Pt$ is nicely scaled to concentration. The ρ_{mag} of $Ce_xY_{1-x}Pt$ is successfully described by Cornut – Coqblin theory. The minimum in the thermopower which one usually ascribes to Kondo minimum, does not correspond to Kondo effect; rather to CEF. The dc susceptibility can be described by the Curie-Weiss law down to about 100 K and also above in the vicinity phase transition. The Curie-Weiss constant at high temperature θ_p, is negative indicating that the interaction between the spin of the Ce ion and conducting electron is antiferromagnetic one. At low temperatures, θ_C is positive indicating the transition into ferromagetic ordered state. The effective magnetic moment per Ce ion, μ_{ef}, at the higher temperatures is the same for all alloys of $Ce_xLa_{1-x}Pt$ and is close to the theoretical value of the isolated Ce^{3+} ion, $\mu = 2.54\mu_B$, indicating the hybridization is very weak and, and, consequently, Kondo effects are weak. At low temperatures, $\mu_{ef} \approx 1.5\ \mu_B$ is also the same for all alloys. On contrary, μ_{ef} of $Ce_xY_{1-x}Pt$ at high as well at low temperatures strongly depend on the Ce content, x. These observations confirm the main important conclusions inferred from the investigations of the transport properties of these alloy systems. Although La and Y are nonmagnetic, they have a strong influence on the different magnetic properties of these two systems, but, interestingly enough, they have no considerable effect on the Curie temperature, T_C. The $T_C(x)$ linearly depends on x and it is about the same for both systems. We show that these systems cannot be considered within Doniach's diagram. The ac susceptibility shows in $Ce_xY_{1-x}Pt$ ($x < 1$) double-peak structure in the vicinity of the phase transition, T_C, which is determined by the resistivity measurements. The peak at lower temperatures corresponds to one-peak structure in $Ce_xLa_{1-x}Pt$ reflecting T_C. *The peak at high temperatures reveal the processes which may be treated as an entrance* $Ce_xLa_{1-x}Pt$ *in a new phase of* $Ce_xY_{1-x}Pt$. *It is stretched within less than 1 K above* T_C *and it is within the Griffiths phase but has quite different underlying physics. This phase is characterized with long range ordered ferromagnetic fluctuations which do not allow spin fluctuations. i.e., Kondo interaction and thus the* Ce^{3+} *is in the stable state just it is in* $Ce_xLa_{1-x}Pt$. *This explains why* $T_C(x)$ is the same for both systems and why *RKKY interaction is not responsible for the ferromagnetism leading us to the conclusion that direct exchange interaction establishes ferromagnetism in these alloy systems.* We believe that the same process takes place in all truly Kondo ferromagnetics. However, it is difficult to be noticed because it takes place in a very narrow temperature interval above T_C. In addition, we noticed this process because we investigated two similar alloy systems where in one them, $Ce_xLa_{1-x}Pt$, hybridization is very weak while in the other one, $Ce_xY_{1-x}Pt$, is very strong.

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