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Environmental effect on the thermoelectrical properties of $CePd_3Ga_x$

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$CePd_3$ is an archetypal intermediate valent compound. Its remarkable feature is an usually large thermoelectric power and a figure of merit Z up to 10^{-3} K^{-1}, interesting from the prospective of thermoelectric cooling applications. Incorporating some small amount of gallium atoms into the cubic unit cell of $CePd_3$ leads to a change in the valence of the cerium atoms towards a stable trivalent state. This transformation brings about distinct changes in the magnetic behaviour of the $CePd_3Ga_x$ alloys. Along increasing the Ga–content the system transforms from a coherent nonmagnetic Kondo lattice to a nonmagnetic single–ion Kondo system and finally to a magnetic dense Kondo system. The magnetic ordering, appearing at low temperatures for $x \geq 0.1$, exhibits initially a short–range character and then becomes of a long–range antiferromagnetic type. Simultaneously, one observes changes in the thermoelectrical properties of $CePd_3Ga_x$. $S(T)$ of the terminal phase $CePd_3$ is dominated by a broad positive maximum of $\sim$ 90 μV/K located at about 120 K. Upon doping with Ga–atoms the maximum shifts towards lower temperatures and considerably rises: for $x = 0.02$ the thermopower is as large as 120 μV/K near $T = 40$ K. With further increase in x , the Seebeck coefficient gradually diminishes. For magnetically ordered alloys the sign of S changes to negative at low temperatures, and $S(T)$ forms a deep negative minimum with values exceeding –20 μV/K for $x = 0.15$.

Keywords : thermoelectrics, intermediate valence, cerium intermetallics