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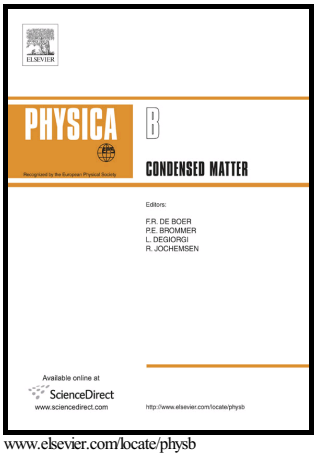

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Effect of Zn-site substitution with Ga on non-Fermi liquid behavior in $PrIr_2Zn_{20}$

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Abstract

$PrIr_2Zn_{20}$ exhibits an antiferroquadrupolar (AFQ) order at T_Q = 0.11 K, above which temperature the electrical resistivity $\rho(T)$ shows an upward curvature and the magnetic specific heat divided by temperature C_m/T follows $-\ln T$ dependence. The non-Fermi Liquid (NFL) behaviors have suggested formation of a quadrupole Kondo lattice. In the present work, we have studied the effect of Ga substitution for Zn on the NFL behavior by the measurements of the specific heat C, the magnetic susceptibility χ, and ρ of $PrIr_2Zn_{20-x}Ga_x$ ($0 \le x \le 0.25$). With increasing x, the characteristic temperature T_0 defined as the temperature where the magnetic entropy S_m reaches $(3/4)R\ln 2$ is increased by a factor of 3.5. Similarly, another characteristic temperature T_R below which $\rho(T)$ starts decreasing with the upward curvature increases with x by a factor of 1.2. The increments of both T_0 and T_R may be attributed to the possible split of the Γ_3 doublet by symmetry lowering of the Pr sites. Otherwise, the quadrupole Kondo lattice would be stabilized by the enhanced *c-f* hybridization due to the increment of the 4*p* electronic density and/or the chemical pressure effect.

Keywords: quadrupole, non-Fermi liquid, quadrupole Kondo effect

I. INTRODUCTION

Praseodymium-based intermetallic compounds PrT_2X_{20} (T = transition metal, X = Al, Zn, Cd) with $4f^2$ configuration have received remarkable attention because of exotic phenomena arising from the quadrupolar degrees of freedom [1]. In the cubic $CeCr_2Al_{20}$-type structure, the Pr ion sits at a symmetric site with the cubic T_d point group [2]. The crystalline electric field (CEF) ground state of the Pr ions in most PrT_2X_{20} systems is the non-Kramers Γ_3 doublet, having no magnetic dipole but electric quadrupoles [3-7]. The active quadrupoles lead to a variety of phenomena at low