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Lattice expansion studies of the crystal structure transformation in intermediate valent Ce_2Rh_2Ga

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The ternary intermetallic compound Ce_2Rh_2Ga exhibits an unusual crystal structure transformation at 128.5 K [1] together with temperature-driven intermediate valence of the nominally trivalent cerium ions below room temperature [2]. Although the two phenomena may have a causal relationship, the origin of the structure transformation remains to be understood. Strongly correlated cerium compounds are renowned for valence instabilities, but structure transformations in cerium compounds are uncommon by comparison. In this study we report on the synthesis and characterization of two doped variants, namely $Ce_{2-x}T_xRh_2Ga$. Here T is the element Y and La respectively in which 10% of the cerium sublattice has been replaced by two elements to achieve positive (Y) and negative (La) chemical pressure respectively. We demonstrate that the parent compound Ce_2Rh_2Ga is amenable to chemical substitution, and both doped variants were confirmed to form in the same orthorhombic ordered version of the La_2Ni_3-structure type at room temperature (space group Cmce) of the undoped Ce_2Rh_2Ga compound. As a single experimental probe of both the cerium valence and the crystal structure transition in the doped compounds we made use of the temperature dependence of dc-magnetic susceptibility. With the results of this study we report on the variations in the paramagnetic Weiss temperature (which is a measure of the magnetic exchange) and the effective magnetic moment values of the cerium ions in the two doped compounds as calculated from the magnetic susceptibility data, and we illustrate the interesting opposing effects obtained by means of control over the crystallographic unit cell volume.

1. S. Nesterenko, A. Tursina, M. Pasturel, S. Xhakaza, and A. Strydom, J. Alloys Compd., 844, (2020) 155570/1-11.
2. H. Sato, T. Matsumoto, N. Kawamura, K. Maeda, T. Takabatake, and A.M. Strydom, Phys. Rev. B 105 (2022) 035113/1-7.

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Yes

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PhD

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