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Scandium-induced ferromagnetism in gadolinium-based magnetoresponsive materials[1] DURGA PAUDYAL, Y. MUDRYK, Ames Laboratory, Iowa State University, Ames, IA 50011, V. K. PECHARSKY, Ames Laboratory, Iowa State University, Ames, IA 50011 and Department of Materials Science and Engineering, Iowa State University, Ames, IA 50011 — Replacement of the strongly magnetic gadolinium atoms with non-magnetic scandium rapidly enhances ferromagnetic interactions in $(Gd_{1-x}Sc_x)_5Ge_4$. This is due to the unique role 3d electron of scandium play in mediating magnetic interactions between the gadolinium atoms from the neighboring layers in the crystal lattice. Our studies confirm that a much higher magnetocaloric effect can be achieved in first-order materials compared to second-order materials of similar structure and composition. Sc concentrations higher than 20% lead to a formation of a closely related Pu_5Rh_4-type structure where first order magnetostructural transformation is replaced by a conventional second-order magnetic ordering. This work also demonstrates how a specific structural feature, more precisely specific interatomic distances and exchange interactions can be utilized to predict anomalous physical behaviors in a series of alloys where conventional wisdom suggests a rather trivial continuous solid solubility and usual magnetism.

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