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Magnetic phase inhomogeneity in frustrated intermetallic compound $Sm_2Ni_{0.87}Si_{2.87}$

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Abstract

A new ternary compound $Sm_2Ni_{0.87}Si_{2.87}$, belonging to intermetallic R_2TX_3 family (R = rare-earth, T = transition metals, X = Si, Ge, *etc.*), could be synthesized in single phase only by the deliberate introduction of lattice vacancies in the Ni and Si sites. The detailed studies of heat capacity as well as dc and ac magnetization including different non-equilibrium dynamical behaviour, *viz.*, aging effect, temperature and field dependent magnetic relaxation and magnetic memory effect establish the compound to be a cluster-glass material having a spin freezing temperature ∼6.6 K. To understand the nature of the glassy phase, experimental results have been analysed using a few different theoretical models and found that the observed magnetic memory effect favours the hierarchical model over the droplet model. Competing exchange interaction driven magnetic phase inhomogeneity could be further confirmed through exchange bias effect. The observed magnetic phase inhomogeneity has been attributed to random magnetic anisotropy that develops due to local environmental variations between the rare-earth ions.

Keywords: Intermetallics, X-ray diffraction, Magentization, Spin glass, Exchange bias

1. Introduction

Magnetic systems in presence of frustration and disorder are a topic of paramount interest in modern condensed matter physics[1, 2, 3, 4, 5]. These type of systems generally exhibit highly degenerate ground states at low temperature, *viz.*, spin-glass[1], spin-ice[6], spin-liquid[7], *etc.*, which are different thermodynamic phases in contrast to simple ordered phases, like, ferromagnetic or antiferromagnetic state. Competing magnetic interactions, lattice geometry and disorder play key role in driving such exotic low-temperature phases. Magnetic frustration may be found in a system where ferromagnetic (FM) and antiferromagnetic (AFM) interactions are of comparable strength[8], whereas geometrical frustration arises when antiferromagnetic interactions are incompatible with some lat-

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