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Magnetic exchange bias phenomena in $Ni_2Mn_{1.4-x}Cr_xGa_{0.6}$

Ramakanta Chapai[1, 2] and **Mahmud Khan**[1]
[1]Miami University, USA
[2]Louisiana State University, USA

The exchange bias (EB) effect, discovered in 1956 by Meiklejohn and Bean, is of great interest both due to its fundamental aspects and its application in technologies including spin valve devices, magnetic recording read heads and giant magnetoresistive sensors. The phenomenon is described as a shift of magnetic hysteresis loop along the magnetic field axis and is interpreted in terms of rough ferromagnetic (FM) and antiferromagnetic (AFM) interfaces, a domain state model and uncompensated interfacial spins. This effect has been observed in polycrystalline samples, single crystals and thin films indicating that it is an intrinsic property, rather than a sample preparation artifact. Here, we present an experimental study on the observation of EB in a series of Cr doped $Ni_2Mn_{1.4-x}Cr_xGa_{0.6}$ Heusler alloys fabricated using arc melting technique. The alloys have been systematically characterized by X-ray diffraction, DC magnetization and AC susceptibility measurements. For all Cr concentration, the alloys exhibit the L10 martensitic structure at room temperature. With increasing Cr concentration the Curie temperature, TC and the saturation magnetization, MS, decrease sharply up to x=0.15 and then suddenly increases. EB effect under both zero field cooled and field cooled protocols have been observed in all alloys with x<0.3. The AC susceptibility data of the alloys show frequency dependence with the low temperature magnetic anomaly shifting to higher temperatures with increasing frequency. The experimental results are explained on the basis of competing FM and AFM interaction leading to spin glass type of ground state.

Biography

Ramakanta Chapai is currently a graduate student in the Department of Physics from Louisiana State University.

rchapa3@lsu.edu

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