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Negative magnetization and exchange bias effect in $Ni_{1.4}Mn_2Ga_{0.6}$
ABDULLAH ALBAGAMI, MAHMUD KHAN, Miami University — Ni-Mn-X based Heusler alloys have attracted significant interest in recent years due to their multifunctional properties. Exchange bias (EB) is one such property that results from competing magnetic interactions in these alloys. The EB effect is typically observed in materials where ferromagnetic (FM) and antiferromagnetic (AFM) interactions co-exist. Since the discovery of EB effect in CoO (AFM) coated Co (FM) nanoparticles by Meikle John and Bean in 1956, a significant amount of research efforts have been made on this subject. Here, we have performed an experimental study on the magnetic and exchange bias properties of polycrystalline $Ni_{1.4}Mn_2Ga_{0.6}$ alloy by X-ray diffraction, dc magnetization, and ac susceptibility measurements. The material exhibits a ferromagnetic Curie temperature of ∼300 K. The magnetization versus field data obtained at 5 K under zero field condition exhibits a double shifted hysteresis loop that disappears at higher temperatures. When the sample is cooled from room temperature to 5 K in applied magnetic fields, exchange bias is observed, whose magnitude is strongly dependent on the cooling field. A maximum exchange bias field of 730 Oe is observed under field cooling condition at 5 K. A negative magnetization is observed in the magnetization versus temperature data obtained at magnetic fields smaller than 75 Oe. The experimental results are explained in terms of the competing ferromagnetic and antiferromagnetic exchange interaction that exist in the materials due to the Mn atoms occupying multiple crystalline sites resulting in a spin glass-type frustrated ground state.

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