Abstract Submitted
for the MAR17 Meeting of
The American Physical Society

Magnetic entropy changes with zero hysteresis loss in the vicinity of the first-order phase transition in $Ni_2Mn_{0.55}Co_xCr_{0.45-x}Ga$ Heusler alloys JEFFREY BROCK, MAHMUD KHAN, Miami Univ — The observation of mitigated drawbacks in a material exhibiting a first-order magnetostructural phase transition near room temperature as well as moderate magnetocaloric effects are pertinent towards the realization of energy-efficient and environmentally-friendly solid state refrigeration technologies. The main drawbacks of a first-order material are hysteresis losses, which dramatically reduce cooling efficiency. Here, we present an experimental study on a set of $NiMn_{0.55}Co_xCr_{0.45-x}Ga$ ($x = 0$, 0.1) Heusler alloys. X-ray diffraction, dc magnetization, and differential scanning calorimetry measurements have been performed on these materials. At room temperature, the alloys were found to crystallize in the tetragonal martensite structure ($P6_3/mcm$). Magnetization measurements showed that both samples exhibited a single first-order magnetostructural phase transition, and that the replacement of Cr with Co shifted the transition temperature from 250 K ($x = 0$) to 290 K ($x = 0.1$), while narrowing the thermal hysteresis from 4 K to 1.7 K. Magnetization measurements also revealed that the Co-substituted alloy exhibited near-zero magnetic hysteresis, including near T_C. Calorimetric data showed that the first-order magnetostructural phase transition of the Co-substituted alloy had near-perfect reproducibility over many thermal cycles. For a magnetic field change of 0 – 2 T, the Co-substituted sample exhibited a magnetic entropy change and refrigerant capacity of 3.14 J kg^{-1} K^{-1} and 54.54 J kg^{-1}, respectively.

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Date submitted: 11 Nov 2016 Electronic form version 1.4