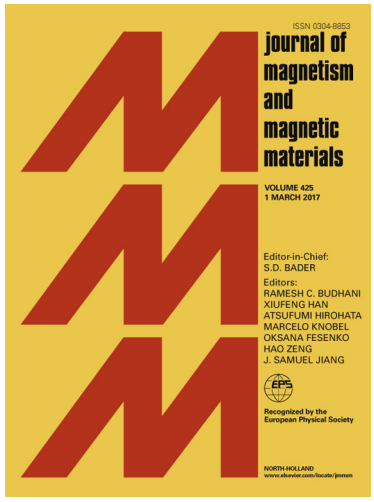

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Anuj Rathi, Vamsi M. Meka, Tanjore V. Jayaraman

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Synthesis of nanocrystalline equiatomic nickel-cobalt-iron alloy powders by mechanical alloying and their structural and magnetic characterization

Anuj Rathi, Vamsi M. Meka, Tanjore V. Jayaraman*

Department of Mechanical Engineering, University of Michigan, Dearborn 48128 USA

Abstract

Mechanically alloying equiatomic Ni, Co, and Fe powder blends for 9 h resulted in the formation of nanocrystalline equiatomic NiCoFe alloy powders comprised of γ-phase. The crystallite size and the lattice parameter was ~20 ± 5 nm and 0.3597 ± 0.0005 nm, respectively. The mode of the powders was 3-7 μm. The saturation magnetization (M_S) and the intrinsic coercivity (H_{CI}) of the alloy, at 300 K, was ~136 ± 5 Am²/kg and ~2.0 ± 0.2 kA/m, respectively. Both M_S and H_{CI}, irrespective of the milling media and milling atmosphere, decreased with increase in temperature from 60 K to 300 K. At elevated temperatures (400 K to 880 K), the alloy powders maintained the γ-phase up to 640 K, thereafter it was comprised of γ-phase and α-Fe. In the temperature regime 300-640 K, the percentage decrease in M_S and H_{CI} was ~12% and ~30%, respectively. The M_S and H_{CI} at 300 K, after the magnetization versus applied magnetic field (M-H) run at 640 K, was ~136 Am²/kg and ~1.5 kA/m, respectively; while the same after the M-H run at 880 K was ~154 Am²/kg and ~1.0 kA/m, respectively. Annealing of the nanocrystalline alloy powders is likely to improve its soft-magnetic properties.

Keywords: nanocrystalline equiatomic NiCoFe alloy, mechanical alloying, lattice parameter, saturation magnetization, and intrinsic coercivity

* Corresponding author. Email: tvjraman@umich.edu (T. V. Jayaraman)