ID de Contribution: **108** Type: **Poster**

Thermal Stability, Structure, Hyperfine, and Magnetic Properties of Nanostructured FeCo-2.5wt.%Ni Powders

Structure, hyperfine, thermal stability, and magnetic properties of the mechanically alloyed Fe47.5Co50Ni2.5 (Fe47.5) and Fe50Co47.5Ni2.5 (Fe50) powders were investigated by using X-ray diffraction (XRD), 57Fe Mössbauer spectrometry, differential scanning calorimetry, and vibrating sample magnetometer, respectively. The XRD results show the existence of bcc α-Fe type, bcc FeCo, and hcp Co-type structures. 57Fe Mössbauer spectrometry confirms the formation of Fe- and Co-rich environments. The average hyperfine magnetic field and the saturation magnetization exhibit different behaviors up to 24 h but a similar trend after 48 h of milling for both samples. The variation of the coercivity is different up to 12 h of milling but identical after 24 h of milling for both samples. The addition of 2.5wt.%Ni lowers the disordered-to-ordered (Tα⟶α′) and α ⟶ γ (Tα⟶γ) phase transformation temperatures. The structure of ball-milled and heat-treated samples consists of bcc α-Fe type (a = 0.2864–0.2874 nm) and FeCo (a = 0.2853–0.2858 nm) phases with crystallite sizes of approximately 39–54 nm. The saturation magnetization increases to about 201–220 emu/g, and the coercivity decreases to approximately 35–57 Oe after thermal annealing. According to the squareness Mr/Ms ratio, the as-milled and heat-treated powders are multidomain.

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Classification de Session: Session Poster 1: MC3, MC5, MC6, MC11, MC13, MC15, MC16, MC18, MC19, MC25, REDP, posters hors MC

Classification de thématique: MC19 Hétérostructures et interfaces de basse dimensionnalité