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Mechanochemical Synthesis and Magnetic Characterization of Nanocrystalline Fe-Nd Alloys

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Abstract

Synthesis and magnetic feature of nanocrystalline Fe-Nd alloys were the main goal of current research. In this regard, different Fe_2O_3 - Nd_2O_3 powder mixtures with appropriate amounts of CaH_2 were milled in order to fabricate nanocrystalline Fe, $\text{Fe}_{95}\text{Nd}_5$ and $\text{Fe}_{85}\text{Nd}_{15}$ compounds. The produced samples were characterized using X-ray diffraction (XRD), differential scanning calorimetry (DSC), scanning and transmission electron microscopy (SEM and TEM) and vibrating sample magnetometer (VSM). The results showed that, nanocrystalline Fe, $\text{Fe}_{95}\text{Nd}_5$ and $\text{Fe}_{85}\text{Nd}_{15}$ alloys can be synthesized by reduction reaction of Fe_2O_3 , Nd_2O_3 and CaH_2 during mechanical milling. The structure of $\text{Fe}_{95}\text{Nd}_5$ and $\text{Fe}_{85}\text{Nd}_{15}$ alloys was a combination of nanocrystalline Fe and $\text{Fe}_{17}\text{Nd}_2$ phases. The produced alloys exhibited soft magnetic properties with the coercivity and saturation of magnetization in the range of 17-23 kA/m and 16-33 Am^2/kg , respectively. It was found that with an increase in Nd content, the soft magnetic properties of Fe-Nd alloys were abruptly varied.

Keywords: Intermetallic compounds; Magnetic materials; Nanostructures; Mechanochemical synthesis.

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