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Synthesis and Characterization of Magnetic Properties of Hard/Soft Nanocomposite Permanent Magnets

Norlaily Mohd Saiden[1,*], Noor Ariffuddin Jalani[1], Hartini Abdullah[1], Aisyah Rahhiah Ahmad[1], Mohd Firdaus Azmi[1], Ismayadi Ismail[2], Mansor Hashim[2], Elias Saion[1]

[1]Department of Physics, Faculty of Science, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia
[2]Advanced Material and Nanotechnology Laboratory, Institute of Advanced Technology, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia.

*****Corresponding author's e-mail: nlaily@upm.edu.my

Abstract. We report on an investigation of the magnetic properties of nanocomposite ferrite via different technique. Magnetic hard and soft ferrite, $SrFe_{12}O_{19}$/ $Ni_{0.5}Zn_{0.5}Fe_2O_4$ nanocomposites with mass ratio 4:1 were synthesised by using the mechanical alloying (750 rpm) method, physical mixing and high energy ball milling method. The nanocomposite ferrite was calcined at different temperatures from 500°C to 800°C to study the effect of calcination temperature on the magnetic properties of nanocomposite ferrite. The X-Ray Diffraction (XRD) result shows the double phase $SrFe_{12}O_{19}$ and $Ni_{0.5}Zn_{0.5}Fe_2O_4$ existed. The Transmission Electron Microscopy (TEM) image shows the particlesize is agglomerated, due to the attractive force. The magnetisation measurement was obtained at room temperature by using a Vibrating Sample Magnetometer (VSM). For mixing by mechanical alloying, nanocomposite ferrite at 800°C gives the larger value of magnetisation, M_s 46 emu/g which is higher than the M_s of a single phase of $SrFe_{12}O_{19}$, 37 emu/g**.** The remanence ratio, Mr/Ms of nanocomposite ferrite at 800°C gives the value more than 0.5, this proves that the exchange coupling exists with the higher value of M_s. For physical mixing, the highest magnetisation obtains are 51 emu/g at a temperature of 750°C. From this simple technique, we are able to attain good magnetic properties of nanocomposite ferrite nanoparticles with a particle size below 50 nm.

Keywords: nanocomposite, ferrites, magnetic properties