Intisari

Fabrikasi Nanopartikel Magnetik $Ni_{0.5}Zn_{0.5}Fe_2O_4$ dengan Metode Kopresipitasi Serta Karakterisasi Struktur Kristal dan Sifat Kemagnetannya

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Nanopartikel magnetik *Nickel Zinc Ferrite* ($Ni_{0.5}Zn_{0.5}Fe_2O_4$) telah berhasil disintesis menggunakan metode kopresipitasi. Variasi suhu sintesis dan konsentrasi NaOH digunakan untuk preparasi nanopartikel. Hasil analisis *X-ray diffraction* (XRD) mengkonfirmasi bahwa nanopartikel $Ni_{0.5}Zn_{0.5}Fe_2O_4$ memiliki struktur kristal kubik spinel. Profil spektrum XRD menunjukkan kristalinitas meningkat dengan meningkatnya suhu sintesis. Seadangkan pola spektrum XRD menunjukkan penurunan kristalinitas dengan bertambahnya konsentrasi NaOH. Ukuran kristalit sampel yang disintesis pada suhu ruang 12,4 nm dan meningkat seiring meningkatnya suhu sintesis. Sedangkan ukuran kristalit sampel yang disintesis dengan konsentrasi NaOH 1,5 M sebesar 14,4 nm dan menurun dengan meningkatnya konsentrasi NaOH. Nilai parameter kisi tidak mengalami perubahan yang signifikan dengan meningkatnya suhu sintesis maupun konsentrasi NaOH. Citra dari *transmission electron microscope* (TEM) menunjukkan sampel mengalami aglomerasi. Pola citra *selected area electron diffraction* (SAED) menunjukkan cincin difraksi sebagai representasi dari bidang Miller dan mengkonfirmasi sampel adalah polikristalin. Spektrum *fourier transform infrered* (FTIR) menunjukkan dua puncak serapan utama, puncak disekitar 578,3 cm^{-1} dan 400,5 cm^{-1} menandakan sub ruang tetrahedral (A) dan oktahedral (B) dalam struktur spinel yang mengkonfirmasi hasil XRD. Magnetisasi maksimum (σ_s) pada 15 kOe dari sampel meningkat dengan meningkatnya rasio fasa ferit. Nilai koersivitas (H_c) sampel yang disintesis dengan variasi konsentrasi NaOH meningkat dengan meningkatnya ukuran kristalit.

Kata Kunci : *Nickel Zinc ferrite* ($Ni_{0.5}Zn_{0.5}Fe_2O_4$), kopresipitasi, sintesis, konsentrasi NaOH, suhu sintesis, nanopartikel magnetik, struktur kristal.

Abstract

Fabricaton of Magnetic Nanoparticles $Ni_{0.5}Zn_{0.5}Fe_2O_4$ by Co-Precipitation Method and Characterization Of Its Crystal Structures and Magnetic Properties

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Nickel Zinc Ferrite ($Ni_{0.5}Zn_{0.5}Fe_2O_4$) magnetic nanoparticles have been successfully synthesized using the co-precipitation method. Variation of synthesis temperature and concentration of NaOH were used for preparing the nanoparticles. X-ray diffraction (XRD) analysis confirmed that $Ni_{0.5}Zn_{0.5}Fe_2O_4$ nanoparticles have spinel cubic crystal structure. The XRD profile of sample showed that the crystallinities increase with the increaseing of synthesis temperature. Meanwhile the XRD profile of sample showed the crystallinity decrease with the increaseing of NaOH concentration. Crystallite size of sample synthesized at 30°C of temperature was 12.4 nm and then increases with the increasing of synthesis temperature. Meanwhile the crystallite size of samples synthesized at NaOH concentration of 1.5 M was 14.4 nm and then decreases with the increaseing of NaOH concentration. There is no significant change in the lattices parameter size for the samples synthesized with increasing temperatures and NaOH concentrations. Transmission electron microscope (TEM) image showed that the sample was agglomerated. The selected area electron diffraction (SAED) image showed the diffraction ring as representation of Miller plane and confirmed that sample was polycrystalline. Fourier transform infrared (FTIR) spectra showed two main absorption bands, the high frequency band is around 578.3 cm^{-1} and the low frequency band is around 400.5 cm^{-1} which occure from tetrahedral (A) and octahedral (B) sites in the spinel lattice that confirmed the XRD. The maximum magnetization (σ_s) at 15 kOe of the samples increases with the increasing of ferrites phase ratio. The coercivity (H_c) of the samples synthesized with variation of NaOH concentration increases with the increasing of crystallite size.

Keywords: Nickel Zinc ferrite ($Ni_{0.5}Zn_{0.5}Fe_2O_4$), co-precipitation, synthesis, NaOH concentration, synthesis temperature, magnetic nanoparticles, crystal structure