INTISARI

PENGARUH KONSENTRASI Zn DAN SUHU *ANNEALING* TERHADAP STRUKTUR KRISTAL DAN SIFAT KEMAGNETAN NANOPARTIKEL $Co_{1-x}Zn_xFe_2O_4$

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Sampel $Co_{1-x}Zn_xFe_2O_4$ telah berhasil disintesis dengan metode co-presipitasi dan di-*annealing* pada suhu yang berbeda, yaitu 400 °C, 600 °C, 800 °C dan 1000 °C selama 2 jam. Ukuran kristalit diestimasi dengan metode *Scherrer* yang ditemukan menurun dari 9,1 hingga 11,2 nm dengan meningkatknya konsentrasi Zn. Peningkatan suhu *annealing* meningkatkan ukuran kristalit dari 13,4 - 39,2 nm karena adanya pertumbuhan butir. Parameter kisi ditemukan meningkat dari 8,18 - 8,25 Å akibat subtitusi Zn yang memiliki radius ionik lebih besar. Spektra FTIR mengkonfirmasi adanya vibrasi *stretching* pada bilangan gelombang di sekitar 478 dan 586 cm^{-1} pada site tetrahedral dan oktahedral. Baik koersivitas (*Hc*) maupun magnetisasi saturasi (*Ms*) menurun masing-masing dari 34 - 20 emu/g dan 674 - 158 Oe, dengan meningkatnya konsentrasi Zn. Sedangkan *Ms* dan *Hc* masing-masing meningkat dari 51 - 191 emu/g dan 150 - 250 Oe dengan meningkatnya suhu *annealing*. Hal ini dapat dikorelasikan karena adanya pertumbuhan butir serta perubahan mikrostruktur selama *annealing*. Citra TEM juga menjukkan bahwa mikrostruktur dan morfologi nanopartikel berubah secara signifikan pasca *annealing*. Konsentrasi Zn pada x=0,4 dan *annealing* pada suhu 1000 °C memberikan hasil optimum pada nilai *Ms* dan *Hc* nanopartikel $Co_{1-x}Zn_xFe_2O_4$.

Kata Kunci: konsentrasi Zn, suhu *annealing*, struktur kristal sifat kemagnetan

ABSTRACT

EFFECT OF Zn CONCENTRATION AND ANNEALING TEMPERATURE ON CRYSTAL STRUCTURE AND MAGNETIC PROPERTIES OF $Co_{1-x}Zn_xFe_2O_4$ NANOPARTICLES

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$Co_{1-x}Zn_xFe_2O_4$ nanoparticles have been successfully synthesized by co-precipitation method and annealed at different temperatures, i.e. 400°C, 600 °C, 800 °C and 1000 °C for 2 hours. Both XRD and FTIR analyses confirm the formation of cubic spinel phase. The crystallite sizes of nanoparticles was calculated by using Scherrer's formula and found decreased from 9.1 to 11.2 nm by increasing Zn concentration. Increasing annealing temperature gave larger crystallite size ranging from 13.4 to 39.2 nm due to the grain growth of nanoparticles because of thermal treatment. The increase in lattice parameter from 8.17 to 8.21 Å by increasing zinc content as a result of the different ionic radii. The Fourier transform infrared spectroscope (FTIR) spectra also confirmed the existence of symmetric stretching vibration bands of metal ions around 478 and 586 cm^{-1} in tetrahedral and octahedral sites, respectively. Both coercivity (*Hc*) and magnetization saturation (*Ms*) decreased monotonically for as-prepared samples with the increase in Zn concentration. The *Ms* and the *Hc* decrease from 34.3 to 20.3 emu/g and 674 to 158 Oe respectively, by increasing zinc concentration. While the annealed samples showed that *Ms* and *Hc* were observed to be enhanced with the increase in annealing. The *Ms* increased from 51 to 91 emu/g and the *Hc* increased from 150 to 250 Oe by increasing annealing temperature. This could be understood due to the redistribution of cations migrated to their site of preference and the change of microstructural after annealing. The transmission electron microscope (TEM) image revealed that the microstructure and morphology of nanoparticles were change after annealing. Sampel with x=0.8 and annealing at 1000 °C has great of *Ms* and *Hc* $Co_{1-x}Zn_xFe_2O_4$ nanoparticles.

Keyword: Zn concentration, annealing temperature, crystal structure, magnetic properties