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Microstructure, Lattice Strain, Magnetic and Magnetostriction Properties of Holmium Substituted Cobalt Ferrites Obtained by Co-precipitation Method.

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Abstract:

The $CoHo_xFe_{2-x}O_4$ (x=0.00, 0.05, 0.1, 0.15, 0.2) samples were synthesized by chemical co-precipitation technique. The structural properties were studied using X-ray diffraction (XRD). XRD data reveal formation of single cubic spinel phase for the samples having lower concentration of holmium substitution namely x=0.0, 0.05 and 0.10, However, at higher concentrations, x=0.15 and 0.2 few extra diffraction lines belonging to $HoFeO_3$ were observed indicating solubility limit of holmium in the $CoFe_2O_4$ lattice. Williamson – Hall plot was used to determine strain in the samples. Microstructural studies carried out using Scanning Electron Microscopy (SEM) depict significant changes in microstructure with increase in holmium concentration. Microstructure of un-substituted cobalt ferrite sample was found to be very compact and grain growth was further found to be restricted with increase in holmium concentration. DC magnetization recorded using Vibrating Sample Magnetometer (VSM) at room temperature indicates decrease in saturation magnetization with increase in Holmium concentration, which is correlated with the weakening of A-B exchange interactions. Comparatively high values of coercivity and retentivity are obtained for holmium concentration with x = 0.15. Magnetostriction measurements were carried out for two different orientations of strain gauge fixed on plane surface of sample with parallel and perpendicular orientation with respect to direction of external magnetic field. For un-substituted cobalt ferrite sample, maximum value of magnetostriction was found to be -228 ppm at 3.5kG magnetic field. This