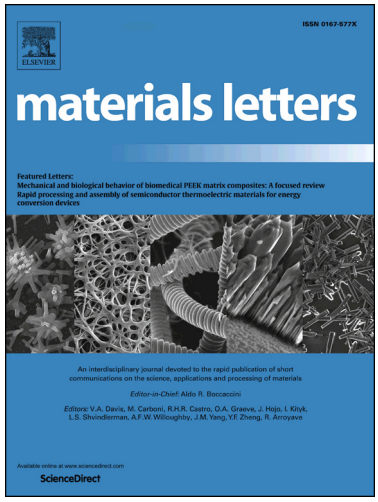

High magnetostriction parameters of sintered and magnetic field annealed Ga-substituted $CoFe_2O_4$

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High magnetostriction parameters of sintered and magnetic field annealed Ga-substituted $CoFe_2O_4$

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Abstract: Impact of substitution of the non-magnetic ion Ga^{3+} for Fe^{3+} on the magnetostriction parameters of $CoFe_2O_4$ has been investigated for samples prepared by a tartrate-gel method. All the Ga-substituted compositions in $CoGa_xFe_{2-x}O_4$ ($0 \le x \le 0.3$) showed higher strain sensitivity ($d\lambda/dH$), at low magnetic fields, compared to that of the unsubstituted sample. The magnetostriction strain (λ) and $d\lambda/dH$ of the composition $CoGa_{0.1}Fe_{1.9}O_4$ could be enhanced from -228 to -296 ppm and -2.20×10^{-9} to -3.55×10^{-9} m/A, respectively, at low magnetic fields, after magnetic field annealing at 300 ^oC.

Keywords: Magnetic materials; cobalt ferrite, magnetostriction, substitution, magnetic field annealing.

1. Introduction

Oxide based magnetostrictive smart materials have gained much attention recently due to their potential applications, and sintered polycrystalline cobalt ferrite ($CoFe_2O_4$) has been studied as a suitable alternative to the currently used costly alloy-based magnetostrictive materials [1-5]. Maximum magnetostriction (λ_{max}) of sintered polycrystalline $CoFe_2O_4$ has been reported in the range 150–400 ppm depending on the synthesis methods and processing conditions [4-7]. Constant efforts have been made to improve or enhance the magnetostriction parameters (both λ and $d\lambda/dH$) of $CoFe_2O_4$ at lower magnetic fields, by changing the processing conditions as well as by metal ion substitution [8-14], to make it suitable for sensor based applications. Song et al [12] studied the magnetic and magnetostrictive properties of Ga-substituted cobalt ferrite, prepared by ceramic method, and showed that significant enhancement in the strain sensitivity, at lower doping levels ($x \le 0.4$) can be obtained at the cost of large drop in the magnetostriction strain. The reported λ_{max} and $|d\lambda/dH|_{max}$ for the composition, $CoGa_{0.2}Fe_{1.8}O_4$, are -100 ppm and -3.2×10^{-9} m/A, respectively, against the values -212 ppm and -1.37×10^{-9} m/A for $CoFe_2O_4$. In this study,

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