AP16

Development of Nanocrystalline $CoGd_xFe_{2-x}O_4$ Particles and its Applications

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Magnetic nanoparticles have attracted increasing interests in fundamental sciences because of their various technological applications. Variation in chemical composition of nanoparticles can modulate the physical properties up to a large extent. In order to understand the doping effect on physical properties of nanocrystalline magnetic particles we have successfully synthesized the $CoGd_xFe_{2-x}O_4$ (with x = 0.0, 0.1, 0.3, 0.5) by chemical route. High purity salts of $CoCl_2$, Fe $(No_3)_3.9H_2O$ and $GdCl_3.6H_2O$ were used. The doped Gd^{3+} ions replace the Fe^{3+} ions at the octahedral sites. The replacement of Fe^{3+} ions by Gd^{3+} ions results the change in physical properties due to different ionic radii. It is therefore ion concentration alters the magnetic and electric property of the doped ion as compared to the original ion. The doping effect on physical properties like crystalline phase, crystallinity, crystallite size, Curie temperature were analyzed by XRD, TGA techniques etc. These nano-particles were further heated at 300°C to understand the diffusion effect at very low annealing temperature.

X-ray diffraction pattern of the developed nano particles of $CoGd_xFe_{2-x}O_4$ confirm the ferrite phase formation. The decrease in crystallinity of the particles with increasing Gd^{3+} concentration has been observed. The replacement of Fe^{3+} ions with the higher atomic radii Gd^{3+} ions in the structure creates stress in the lattice which interns leads to asymmetric behavior and broadens the diffraction peaks.

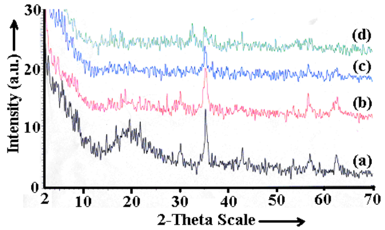

Fig. 1. XRD pattern of $CoGd_xFe_{2-x}O_4$ with (a) x = 0.0; (b) x = 0.1; (c) x = 0.3; & (d) x = 0.5

This material was utilized for the humidity sensor measurement as a function of electrical conductivity. The humidity absorption takes place due to chemi and physical adsorption of the water vapor at the size of nanoparticle in the material. On increasing the Gd concentration it was observed that the humidity sensing increases. The resistance of $Gd_{0.5}$ ferrite is measured as 785MΩ at 10% humidity. However at 80% humidity the resistance of the same sample falls to 183KΩ. Thus substitution of Gd percentage in the sample increases sensing property of humidity. These nanoparticles can be utilized as good humidity sensor in the nano size range. The details of the work are presented in the paper.

AQ01

Electrical Characteristics of Hall and Magnetoresistive Effect Magnetic Field Sensors Fabricated using Ultra-High Mobility 2DEG-InAsSb/InAlSb Heterostructures

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Edwin Hall's observation that a magnetic field distorts the equipotential lines in a current-carrying conductor–Hall effect–is the basis of a multimillion dollar industry. Hall effect and magnetoresistance (MR) sensors are widely used for monitoring rotation, electric currents, and more recently for scanning probe based magnetic imaging and biosensing [1-4]. However, new applications of semiconductor-Hall and MR technology require the development of material systems for producing devices with even higher sensitivity at micrometer scale sensing areas. The key materials requirements are high electron mobility, an ultra-thin conducting layer and low contact resistance. Here, we describe the electrical properties of Hall and MR devices fabricated using 2DEG-InAlSb /InAsSb/InAlSb heterostructures with electrical conduction confined to within the InAsSb layer. The 300K electron mobility and sheet carrier concentration were 36,500 cm^2/Vs and $2.5\times10^{11}cm^{-2}$, respectively. The current sensitivity was 2640 V/A/T, which is about an order of magnitude greater than GaAs pseudomorphic devices. Fig.1 shows the variation of the Hall voltage with applied magnetic field, and drive current for pseudomorphic and antimonide-based materials. We will discuss the effect of varying the thickness and doping of the well-layer on the sensitivity of InAlSb/InAsSb/InAlSb Hall sensors and MR devices.

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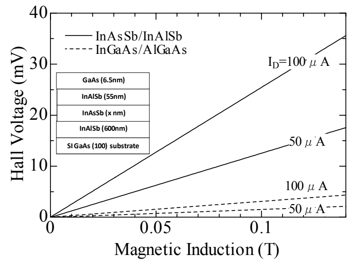

Fig. 1. The variation of the Hall voltage of Hall sensors made using InAsSb/InAlSb and InGaAs/AlGaAs structures.

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