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Enhanced humidity sensing and magnetic properties of bismuth doped copper ferrites for humidity sensor applications

I.C.Sathisha[1], K.Manjunatha[1], Anna Bajorek[2], B.Rajesh Babu[3,4], B.Chethan[5],**T.Ranjeth Kumar Reddy[1]**,Y.T.Ravikiran[6], V.Jagadeesha Angadi[7]
1. Department of Physics, School of Engineering, Presidency University, Bangalore, 560064, India
2. A. Chełkowski Institute of Physics, University of Silesia in Katowice, ul. 75 Pułku Piechoty 1, 41-500, Chorzów, Poland
3. Departamento de Ingeniería de Materiales, Facultad de Ingeniería, Universidad de Concepción, Concepción, 4070409, Chile
4. Department of Physics, G.V.P. College of Engineering for Women, Visakhapatnam, Andhra Pradesh, 530048, India
5. Department of Physics, VTU Research centre, JNN College of Engineering, Shivamogga, 577204, India
6. Deparment of Physics, Govt. Science College, Chitradurga, India
7. Department of Physics, P.C. Jabin Science College, Hubballi, 580031, India

Abstract

In present investigation, the $CuFe_{(2-x)}Bi_xO_4$ (where, x = 0.00, 0.01, 0.02, 0.03) nanoparticles synthesized by solution combustion technique using mixture of fuels as glucose and carbamide. The refined XRD (X-ray diffraction) patterns of the samples confirms the spinel cubic structure having space group *Fd3m*. The average crystallite size was found to be in nanometer. The lattice parameter, volume, strain and hopping lengths were estimated. TEM (Transmission Electron Microscopy) micrographs confirm the particles are agglomeration. SAED (Selected Area Electron Diffraction) pattern reveals the polycrystalline nature of the material. The magnetic nature of spinel ferrite can be explained by Neel's two sub-lattice model. In the present work, the observed decrease in magnetization can be ascribed to occupancy and migration of cations at/from B sites by the substitution of Bi^{3+} ions. The magnetic parameters such as saturation magnetization, remanent magnetization (M_r), coercivity field (H_c), remanence (S), uniaxial anisotropy (K_u) and cubic anisotropy (K_c) were estimated. The resistance and humidity sensing responses increases with increase of the Bi^{3+} concentration. The hysteresis curves reveal the desorption process is somewhat slower than the adsorption process. The sensing response time 73 s was recorded when sample was moved from 11% RH to 97% RH and the recovery time 36 s was recorded when sample was moved from 97% RH to 11% RH. The humidity sample shows exceptionally stable response at relative humidity 99% RH and 33% RH.

Keywords:

X-ray diffraction, Humidity sensors, Saturation magnetization, Hysteresis
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