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Magnetoelectric and dielectric properties of $PbZr_{0.52}Ti_{0.48}O_3$ $Co_{0.6}Zn_{0.4}Mn_{0.3}Fe1.7O_4$- $PbZr_{0.52}Ti_{0.48}O_3$ trilayer composites

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Abstract

In this paper we report the magnetoelectric and dielectric properties of $Pb_{0.52}Ti_{0.48}O_3$- $Co_{0.6}Zn_{0.4}Mn_{0.3}Fe_{1.7}O_4$- $PbZr_{0.52}Ti_{0.48}O_3$ (PZT-CZFMO-PZT) trilayer composite samples. Samples were prepared using co-sintering method with different thickness values (0.6mm, 1.2mm, 1.8mm) of CZFMO and constant thickness value (~ 0.5 mm) of top and bottom PZT layers. The magnetoelectric coupling coefficient (α_E) of these samples was studied in both longitudinal and transverse modes. In each sample the highest ME coefficient was obtained in the transverse mode due to low value of demagnetization in this direction. The highest transverse ME voltage coefficient (~64 mV/cm.Oe) was obtained for the sample containing the thickest layer of CZFMO at the frequency ~ 1 kHz for H_{dc}=600 Oe. The piezoelectric coefficient (d_{33}) was observed to nearly constant (~ 85 pC/N) for all composite samples. The polarization (P) vs. electric (E) loop measurement on these samples revealed low values of remnant polarization (1-2 $\mu C/cm^2$) and coercivity (~ 8 kV/cm) as compared to pure PZT. The loss tangent (tan δ) vs frequency (ω) curve for all samples showed the characteristic relaxation peak in frequency range (~5 kHz-10 kHz) that might be related to PZT. The resonance characteristics of these samples were measured using capacitance spectrum method. The resonance frequency and band width were noted to be 49 MHz and 8 MHz respectively. The ferroelectric to paraelectric transition temperature (Tc) for all composite samples was observed to be slightly shifted in comparison to pure PZT indicative of slight inter-diffusion between different layers during the sintering process. The scanning electron micrographs of the interfacial region showed good mechanical adhesion between the component layers. The magnetization vs field loop (M-H) measurements were performed to examine the magnetic nature of these samples.

Biography

Arti Gupta has completed her Ph.D from Indian Institute of Technology, Delhi in 2011. She has published 7 papers in the reputed international journal. In 2012 she got the prestigious Inspire faculty fellowship funded by Department of Science and Technology, Government of India. At present she is working as an Inspire Faculty in the Department of Physics, University of Delhi, India under research supervision of Prof. R. P. Tandon.