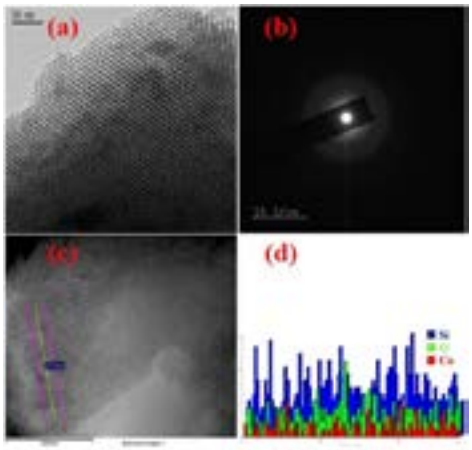
Debasish Biswas et al., J Material Sci Eng 2019, Volume 8
DOI: 10.4172/2169-0022-C6-140

Observing giant room temperature magneto dielectric response *in silica*-based oxide nano glass

Debasish Biswas[1], **Anupam Maity**[1,2], **Subha Samanta**[2] and **Dipankar Chakravorty**[2]
[1]Jadavpur University, India
[2]Indian Association for the Cultivation of Science, India

Nano dimensional silica-based glasses of compositions $xCoO-(1-x)SiO_2$ with x having values 10 and 30 were synthesized by a sol-gel method within the nanopores of mesoporous template. X-ray photoelectron spectroscopic (XPS) analysis showed the presence of Co^{2+} and Co^{3+} species in the glasses causing electronic conduction in this amorphous system. At room temperature the resistivity values exhibited by the nano glasses were nearly three orders of magnitude lower than those of the corresponding bulk glasses. The resistivity data for the nano glasses on analysis confirmed the conduction to arise due to small polaron hopping between the localized states represented by those ions. Typical values of inter-site separation distance extracted from the said analysis were found to be ~7 Å. The values of magneto dielectric parameter for the different nanocomposites were large with the highest value found to be in the range 500% to 45% for the frequencies 1 kHz and 1 MHz respectively for a nanocomposite with glass composition of $30CoO-70SiO_2$. The results were then fitted to Catalon's model based on two dielectrics in series with different resistivity values. The satisfactory fit of the measured data to the theoretical model based on a negative magneto resistance of the nano glasses indicate that an enhancement of spin polarized electron hopping caused this effect. The magnetization change as a function of the applied magnetic field was calculated for the nanocomposites. The super exchange interaction between Co^{2+} and Co^{3+} ions through the intervening oxygen ions gave rise to the ferromagnetic like behaviour of the samples. In future these materials may be used as good magnetic sensors.



Recent Publications

1. Sanfui M, Haldar D K and Biswas D (2016) Studies on different Geophysical and extra-terrestrial events within the Earth-ionosphere Cavity in terms of ULF/ELF/VLF Radio waves. Astrophys. Space Sci. 361:325.
2. Dey A, Das M, Datta J, Jana R, Dhar J, Sil S, Biswas D, Banerjee C, Ray P P (2016) Development of large area nanostructured silicon-hydrogen alloy material with improved stability for solar cell application by argon dilution method. Electron. Mater. Lett. 12:456-461.
3. Islam K, Bhattacharyya D, Ghosh A, Biswas D and Bandyopadhyay A (2017) Study on the probe field propagation in presence of control and coupling fields through a four-level N-type atomic system. J. Phys. B: At. Mol. Opt. Phys. 50:215401.
4. Maity A, Samanta S, Chatterjee S, Maiti R, Biswas D, Saha S K and Chakravorty D (2018) Giant Dielectric Permittivity in Interrupted Silver Nanowires Grown within Mesoporous Silica. J. Phys. D: Applied Physics 51:245301.
5. Samanta S, Maity A, Chatterjee S, Maiti R, Biswas D, Giri S and Chakravorty D (2018) Rice-Bernasconi Gorkov-Eliashberg effect of giant dielectric permittivity *in silica*-based films containing interrupted silver nanowires. Trans. Indian Inst. Met. 51(24):1-7.

Biography

Debasish Biswas has obtained his PhD in Experimental Physics at the University of Calcutta in 1999; Postdoctoral research work on ion trap spectroscopy in Penning trap. He has published in areas relating to spectroscopic study of atmospheric molecules and trace gases. Currently, he is a Professor in the Department of Physics at Jadavpur University, Kolkata, India and his primary role is of an Educator. His current research interest includes nanomaterials, space physics and atom optics..

Notes: