DIELECTRIC INVESTIGATIONS OF THE $BiFe_{1-x}Cr_xO_3$ CERAMICS

Vaiva Gribauskaitė[1], Edita Palaimienė[1], Jūras Banys[1], Anatoli V. Pushkarev[2], Yury V. Radyush[2], Nikolai M. Olekhnovich[2]

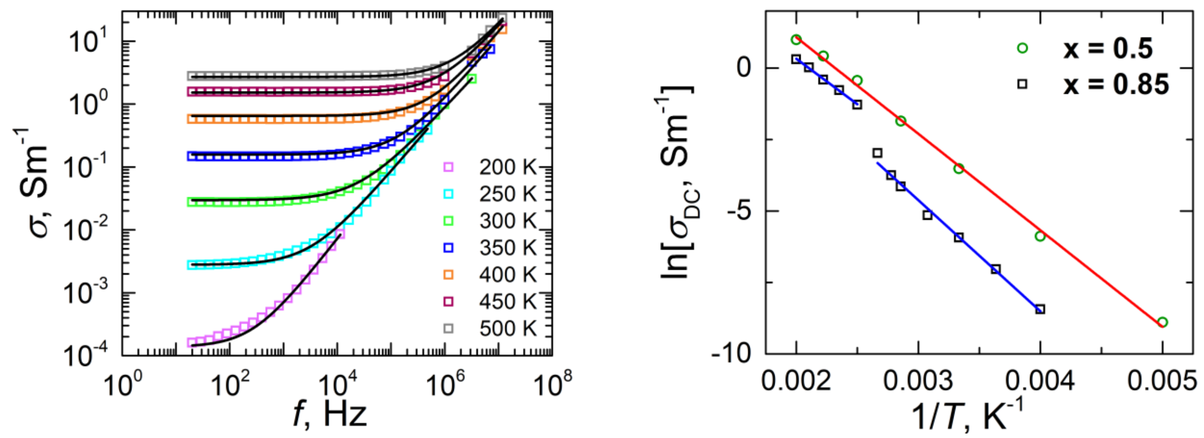
[1] Institute of Applied Electrodynamics and Telecommunications, Vilnius University, Sauletekio 3, LT- 10257 Vilnius, Lithuania

[2] Scientific-Practical Materials Research Centre of NAS of Belarus, P. Brovka str. 19, 22072 Minsk, Belarus

vaiva.gribauskaite@ff.stud.vu.lt

Multiferroic materials attract scientific interest because they exhibit ferroelectric and magnetic ordering in a single phase. Bismuth ferrite, $BiFeO_3$ (BFO), shows ferroelectric (FE) and ferromagnetic (FM) ordering above room temperature [1]. In order to extend studies and investigate multiferroic materials BFO is doped with various elements (La, Nd, Sm, Gd and Cr). The following work is aimed to investigate the dielectric properties of chromium substituted bismuth ferrite ceramic ($BiFe_{1-x}Cr_xO_3$) by the impedance spectroscopy.

The electrical conductivity σ^* is calculated using equation $\sigma^* = i\varepsilon^*\varepsilon_0\omega$. Fig 1(a) shows the frequency dependence of conductivity at different temperatures for the $BiFe_{1-x}Cr_xO_3$ ceramics (x = 0.5). The conductivity follows the Almond-West law [2] from which it is possible to determine DC conductivity. With decreasing Cr content the DC conductivity can be determined at lower temperatures in our measurements frequency range. For example, DC conductivity can be determined at 200 K for x = 0.5 and at 250 K for x = 0.85. From the σ_{DC} values obtained at different temperatures the activation energy (E_A) was calculated using the Arrhenius law $\sigma_{DC} = \sigma_0 \exp(-E_A/kT)$ (Fig. 1(b)). Obtained values are $E_A = 0.29 \pm 0.01$ eV (for x = 0.5), $E_A = 0.33 \pm 0.01$ eV and $E_A = 0.27 \pm 0.01$ eV (for x = 0.85). Sudden change of activation energy for x = 0.85 at 385 K is attributed to the phase transitions that occur near room temperature for the compositional range of $0.6 < x \leq 0.9$ [3].



a) **b)**

Fig. 1. (a) Frequency dependencies of DC conductivity at different temperatures for $BiFe_{0.5}Cr_{0.5}O_3$ ceramics. (b) The 1/T dependence for $BiFe_{1-x}Cr_xO_3$ ceramics.

[1] H. Shima, H. Naganuma, S. Okamura. Optical Properties of Multiferroic $BiFeO_3$ Films. Materials Science: Advanced Topics. DOI: 10.5772 / 54908 (2012).

[2] M. R. Panda. Investigations on Structural and Electrical Properties of Li_2NiSiO_4. International Journal of ChemTech Research v. 6, p. 1962-1964 (2014).

[3] I. P. Raevski, S. P. Kubrin, A. V. Pushkarev, N. M. Olekhnovich, Y. V. Radyush, V. V. Titov, M. A. Malitskaya, S. I. Raevskaya, H. Chen. The effect of Cr substitution for Fe on the structure and magnetic properties of $BiFeO_3$ multiferroic. Ferroelectrics v. 525, p 1-10 (2018).