Effect of Heat Treatment on Impedance Spectra of $Na_{0.5}Bi_{0.5}TiO_3$ Single Crystal

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Ferroelectric sodium bismuth titanate $Na_{0.5}Bi_{0.5}TiO_3$ (NBT) is one of the most promising materials for use in electro-mechanical transducers [1]. Earlier it was shown that thermal annealing of NBT crystals in the different atmospheres and at various temperatures made it possible to control the content of the structural defects created by oxygen vacancies. In the abstract we study complex impedance spectra of NBT single crystals heat treated in air. Heat treating was performed at 900 K and subsequently at 1100 K for 1 h. After each treatment stage the impedance spectra were measured. Impedance spectra studying was carried out in the temperature interval from 600 to 900 K and in the frequency range of $5\text{-}5\cdot10^5$ Hz by using Tesla BM-507 impedance meter.

The spectra of specific impedance are presented in Fig. 1 as diagrams in the complex (ρ"-ρ') plane. For the samples annealed at 900K the experimental hodographs consist of two arcs. Annealing at 1100 K changes form of hodograph, which consists of only single low-frequency arc. One can see that conductivity in DC field $\sigma(\omega=0)=1/\rho'(\omega=0)$, determined from hodographs intersections with abscissa axis, is significantly reduced after annealing at 1100K.

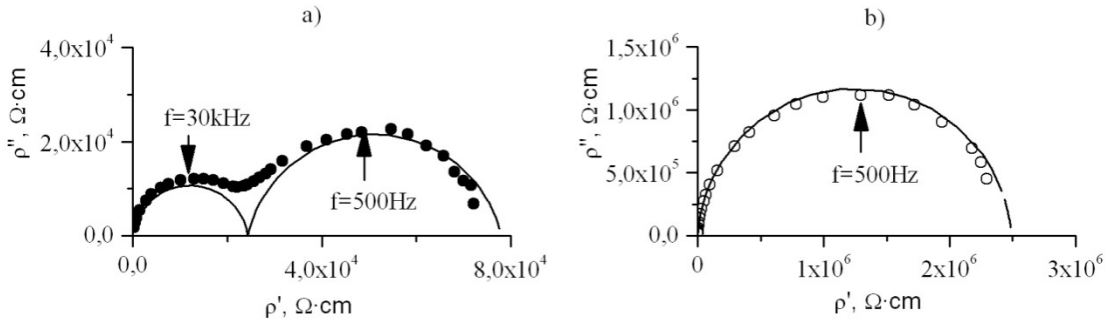

Fig.1. Impedance spectra for NBT single crystals annealed in air for 1h at: (a) 900K; (b) 1100K.

It is argued that annealing in air significantly reduces content of oxygen vacancies that results in conductivity decreasing. Accounting features of NBT structure and results in [2, 3], one can assume that the arcs on the experimental hodograph correspond to hopping charge transfer and contain contribution of ionic and electronic components. Ionic transport can be carried out by movement of oxygen vacancies. Electrons can jump over the traps, such as F^+ centers.

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3. Kruzina T.V., Sidak V.M., Trubitsyn M.P., Popov S.A., Suchanicz J. Mechanisms of electroconductivity in $Na_{0.5}Bi_{0.5}TiO_3$ single crystals // Visnyk KhNU. – 2015. – 23. – P.120.