Kalcio įtaka dielektrinei $BaZr_xTi_{1-x}O_3$ kietųjų tirpalų relaksacijai

Dielectric relaxation in Ca-modified $BaZr_xTi_{1-x}O_3$ solid solutions

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Barium titanate (BTO) is a first inorganic material where the ferroelectricity was discovered. Barium titanate has a perovksite structure in which ferroelectricity occures due to the off-centering of Ti ions in oxygen octahedral cage. The material undergoes three consecutive phase transitions [1]. The high temperature phase is paraelectric which transforms to the tetragonal, orthorhombic and rhombohedral ferroelectric phases when the temperature decreases.

Barium titanate can be considered as a multifunctional materials for different applications. The largest application area of BTO is multilayered ceramic capacitors due to its large weakly temperature dependant permittivity in the vicinity of room tempreature. Unfortunately, the loss and energy storage density of such capacitors are strongly dependant on the domain structure of the ferroelectric phase of BTO. In order to maximize the energy storage density and decrease the loss which arise due to domain wall motion, it is necessary to modify BTO to pin the domains or reduce their density.

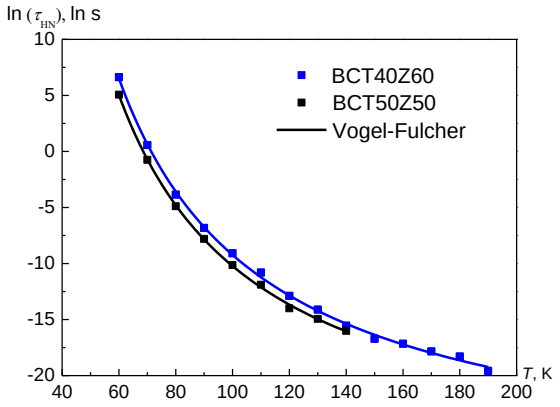

Fig. 1 Temperature dependence of Havriliak-Negami relaxation time in BCZT solid solutions.

One of effective ways to diminsh domains and their walls is to incorporate different ions in the A and/or B sites of perovskite lattice. The most popular ions to introduce instead of titanium are Zr^{4+} [2] , Sn^{4+} [3,4], Ce^{4+} [5]. These isovalent substitutions diminishes ferroelectric behaviour. A gradual transition from ferroelectric to relaxor properties are observed. The dielectric anomaly is shifted to lower temperature with an increase of dopant concentration. This is attractive feature since the paraelectric phase is stabilised at room temperature. Thus, it is a good feature for potential application since the losses will be diminished while frequency independant large permittivity persits.

In this contribution we investigate how 10 percent of calcium ions at the A-site modifies the dielectric relaxation for two prominent $BaZr_xTi_{1-x}O_3$ (x = 0.5 and 0.6) compositions. Figure 1 represents the temperature dependence of Havriliak-Negami relaxation time in both compositions. It will be revealed that the dielectric anomaly is further shifted to lower temperatures. Calcium ions do not modify polar fluctuations in these materials.

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Keywords: dielectric spectroscopy, ferroelectricity, perovskites, phase transitions, relaxor ferroelectrics

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