$(Bi_xNa_{1-x})(Mn_yNb_{1-y})O_3$ keramikų fazinė diagrama

The phase diagram of $(Bi_xNa_{1-x})(Mn_yNb_{1-y})O_3$ ceramics

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Sodium niobate ($NaNbO_3$) is an oxygen perovskite with the largest number of phase transitions [1]. The phase transition in sodium niobate can be induced by temperature, electric field and particle size [2]. The material gained new attention in the last years due the increased interest in environmental protection, since it is an end member of a number of solid solutions with good piezoelectric properties (for example $Na_{0.5}K_{0.5}NbO_3$) which could replace the widely used lead-based perovskites. $NaNbO_3$ co-doped with N and Mn ions attracts attention for photocatalytic studies [3]. $BiMnO_3$ is well known antipolar ferromagnet, earlier claimed as multiferroic [4]. In this presentation results of broadband dielectric investigations of mixed $(Bi_xNa_{1-x})(Mn_yNb_{1-y})O_3$ (x=0, y=0; x=1, y=1, and x=0.06, y=0.04) ceramics in wide temperature region (25-730 K) are presented. Five phase transitions were observed in $NaNbO_3$ ceramics on cooling by broadband dielectric investigations in temperature range from 25 K to 1000 K. Despite that T_1-T_2 and S-T_1 phase transitions are non polar, they are clearly expressed in dielectric properties of ceramics due the corresponding conductivity anomalies. At higher temperature (above 600 K) the electrical conductivity dominates in the dielectric spectra of ceramics. The electrical conductivity have peculiarities close to T_1-T_2, S-T_1, P-R phase transitions temperatures. In mixed $(Bi_xNa_{1-x})(Mn_yNb_{1-y})O_3$ with x=0.06 and y=0.04 the antiferroelectric phase transitions P-Q and Q-R are clearly expressed in dielectric properties, most of phase transitions are shifted to higher temperatures (Fig. 1). At lower temperatures (below 100 K) domains wall dynamics dominate in the dielectric spectra of both composites and the freezing temperature was calculated. At higher x values ($x \geq 0.5$) no ferroelectric phase transition was observed. The microscopic origin of phase transition will be discussed in presentation. The possible multiferroic behaviour for x=04 will be also discussed in the presentation. The dielectric properties of $BiMnO_3$ are dominated by the huge electrical conductivity and Maxwell-Wagner relaxation. The conductivity activation energy non evenly decreases on heating and due substitution Na→Bi and Nb→Mn. The variation in activation energy relates to the level of ionization of oxygen vacancies and to effects of the high temperature annealing. The electrical properties will be also discussed in terms of the complex impedance and the distribution of relaxation times. The small polaron mechanism of conduction is proposed.

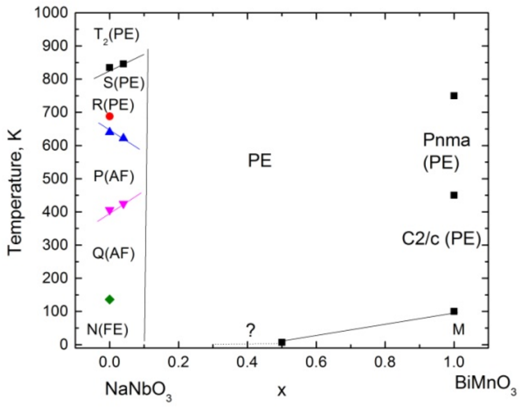

Fig. 1 Phase diagram of $(Bi_xNa_{1-x})(Mn_yNb_{1-y})O_3$ ceramics

Keywords: ferroelectrics, ceramics, dielectric permittivity.

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