ABSTRACT OF THE DOCTORAL THESIS

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Title: "Properties of solid solutions based on sodium potassium niobate $Na_{0.5}K_{0.5}(Nb_{1-x}Sb_x)\ O_3$ and $Na_{0.5}K_{0.5}(Nb_{1-x}Sb_x)O_3$ + 0.5 mol% MnO_2".

Piezoelectric materials that convert mechanical energy into electricity, and vice versa, are commonly used in transducers, sensors, actuators, etc. Most of them have a perovskite structure and are based on lead. Among them, the most representative is the solid solution $PbZrO_3$ - $PbTiO_3$ (PZT) used in electronics since the late 1950s. However, the presence of toxic lead in the composition of these solutions generates problems related to contamination of the broadly understood natural environment. It happens on the production phase, during use and recycling phase of used electronic components. There are a number of European Union (EU) directives which recommend the replacement of these materials with non-toxic compounds.

The subject of this work are lead-free solid solutions $Na_{0.5}K_{0.5}NbO_3$, $Na_{0.5}K_{0.5}NbO_3$+0.5% mol MnO_2, $Na_{0.5}K_{0.5}(Nb_{1-x}Sb_x)O_3$ and $Na_{0.5}K_{0.5}(Nb_{1-x}Sb_x)O_3$+0.5% mol MnO_2. The main purpose of this dissertation is a study of impact of Sb and Mn ions additives introduced to $Na_{0.5}K_{0.5}NbO_3$ on the properties of obtained compounds.

As part of this study, $Na_{0.5}K_{0.5}NbO_3$, $Na_{0.5}K_{0.5}NbO_3$+0.5% mol MnO_2, $Na_{0.5}K_{0.5}(Nb_{1-x}Sb_x)O_3$ and $Na_{0.5}K_{0.5}(Nb_{1-x}Sb_x)O_3$+0.5% mol MnO_2 were obtained in the solid phase reaction method. Then, their microstructural, structural, thermal, dielectric, piezoelectric, ferroelectric and mechanical properties were tested and analyzed. These measurements were performed as a function of temperature, frequency (dielectric) and uniaxial pressure (dielectric and ferroelectric). Dielectric and ferroelectric properties studies under uniaxial pressure and mechanical study were carried out for these materials for the first time.

To sum up, it can be stated that the manipulations of parameters of the broadly defined crystal structure (including network parameters) by changing the technological conditions for obtaining sodium potassium niobium and modifying its chemical composition are relatively simple, low-cost and effective ways to strengthen its properties.