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Crystalline structure and dielectric properties of ceramic materials based on $AgNbO_3$

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Abstract

Using the data of qualitative X-ray phase analysis, it was shown that in a wide concentration range at 1223 K compounds based on silver niobate are formed in the condition of the heterovalent substitution of tungsten(VI) ions for niobium(V) ions. These compounds are isomorphic to a perovskite-type structure. Microprobe analysis data allows to determine the homogeneity of the analyzed samples and the correspondence of their experimental compositions to the theoretical ones for the formula $Ag_{1-x}Nb_{1-x}W_xO_3$. Using the data of X-ray diffraction analysis (Rietveld method) in the Crystallography Data Analysis Software – GSAS, the crystal structure of the obtained compounds was refined. The surface morphology of samples having been obtained at 1373 K was investigated by scanning electron microscopy (SEM). It was shown that with an increase of Nb^{5+} to W^{6+} substitution degree for $Ag_{1-x}Nb_{1-x}W_xO_3$ ceramic samples in the range of the ($0.2 \le x \le 0.8$) molar ratio, the average particle size for the studied compositions grows from 1.3 to 5.2 μm, respectively. For the obtained ceramic compounds based on silver niobate with a perovskite-like structure (tetragonal distortion), the temperature-frequency dependences of dielectric parameters in the range 300-900 K were studied. It was found that samples slowly cooled from 1373 K are characterized by low values of ($\varepsilon \sim 10$) and loss ($tg\delta \sim 0.004$ at $f = 1$ kHz) at room temperature. The ceramics obtained are characterized by relatively high values of dielectric permittivity ε at low frequencies and/or high temperatures. The dielectric parameters of the obtained ceramics are similar to the characteristics of so-called "colossal" dielectric constant materials. The revealed features of the dielectric characteristics of quenched ceramics apparently result from Maxwell-Wagner relaxation at intercrystalline contacts.

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