Thermal behavior and dielectric properties of $Bi_2CaNb_{2-x}Fe_xO_{9-\delta}$

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Solid solutions of $Bi_2CaNb_{2-x}Fe_xO_{9-\delta}$ were obtained by the method of solid phase synthesis. The thermal analysis of the samples revealed diffuse low- and high-temperature exo-effects in the DSC curves in the temperature ranges of 493–673 K and 1123–1223 K. According to the high-temperature X-ray diffraction results, the exothermic effect in the range of 1123–1223 K is related to ferroelectric phase transition from polar (A21am) to nonpolar phase (I4/mmm). The high-temperature X-ray diffraction detected no reconstructive phase transitions in calcium bismuth niobate or its solid solution in the low temperature range of 493–673 K. The study of the electrical properties of $Bi_2CaNb_{2-x}Fe_xO_{9-\delta}$ samples (x = 0.06 and 0.10) showed that the substitution of niobium with iron led to the increase in the direct current electrical conductivity of the sample. In this case, the dielectric loss decreased and the dielectric permittivity increased. The studied solid solutions were characterized by the low-frequency ion-migration polarization. The radical change in the electrical characteristics including the almost double activation energy growth, the maxima of the LF and HF relaxation times and the maximum of polarization inhomogeneity were observed at the temperatures of 573–598 K. That was probably caused by the phase transition accompanied by activation of oxygen ions. Thus, the impedance spectroscopy and thermal analysis data correlate well pointing the reproducibility of the low-temperature effect recorded by the thermal analysis methods.