Influence of Nb2O5 substitution on the structural and electrical properties of Bi3TaO7 ceramics

ABSTRCT

Herein we report the doping mechanism and impedance study of the Nb-substituted Bi3Ta1-xNbxO7 ($0 \leq x \leq 0.5$) prepared via conventional solid-state method at 900 °C over 24 h. The substitutional solid solution crystallised in a cubic fluorite structure, space group Fm-3m and with lattice parameter, $a = b = c$, in the range 5.4477 (±0.0037)–5.4654 (±0.0011) Å. An insignificant unit cell expansion was observed with increasing Nb2O5 content and the linear correlation between lattice parameter and composition variable showed that the Vegard's Law was obeyed. Both TGA and DTA analyses confirmed that the Bi3Ta1-xNbxO7 solid solution was thermally stable as neither phase transition nor weight loss was observed within the studied temperature range, ~28 °C–1000 °C. The electrical conductivities of these samples were found to increase with increasing Nb concentration; the Bi3Ta0.5Nb0.5O7 exhibited the highest conductivity, $\sim 1.2 \times 10^{-2}$ S cm^{-1} at 700 °C with a low activation energy of 1.03 eV.

Keyword: Solid-state method; Niobium-substituted bismuth tantalate; Solid solution; Conductivity.