Novel monoclinic zirconolite in Bi2O3-CuO-Ta2O5 ternary system: phase equilibria, structural and electrical properties

ABSTRACT

Synthesis of novel monoclinic zirconolite, Bi1.92Cu0.08(Cu0.3Ta0.7)2O7.06 (ɓ-BCT) using solid state reaction had been finalised at the firing temperature of 900 °C over 24 h. The Xï ray diffraction pattern of ɓ-BCT was fully indexed on a monoclinic symmetry, space group, C2/c with lattice constants, a = 13.1052 (8), b = 7.6749 (5), c = 12.162 (6), Ŭ= ɔ = 90° and ɓ = 101.32° (1), respectively. The reaction mechanism study indicated phase formation was greatly influenced by the reaction between intermediate bismuth tantalate binary phases and CuO at elevated temperatures. ɓ-BCT was thermally stable up to a temperature of 900 °C and contained spherulite grains with sizes ranging from 1 to 14 ε m. Electrical properties of this material were characterised over a broad temperature range covering temperatures from 10 K to 874 K. At the temperature of 304 K, two semicircles were discernible in complex Coleï Cole plot showing an insulating grain boundary with Cgb = 6.63 × 10ī 9 F cmī 1 and a bulk response capacitance, Cb = 6.74 × 10ī 12 F cmī 1. The Power law frequency-dependent ac conductivity of ɓ-BCT was apparent in three frequency regimes; a lowï frequency plateau regime, a high-frequency plateau regime and a dispersive regime taking place in the temperature range of 220ï 576 K. The frequency-dependent ac conductivity of ɓ-BCT with increasing temperature was attributed to the thermal activated electrical conduction mechanism within the structure.

Keyword: Ceramics; Solid state reaction; Dielectric response; Ac impedance spectroscopy