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Dendrite microstructure of barium strontium titanate based glass-ceramics

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Glass-ceramics containing ferroelectric grains surrounded by a glass matrix are of significant interest for applications in power electronics due enhanced energy storage capabilities [1]. Glass-ceramics based on barium-strontium titanate (BST) is one of the most promising materials due to its high dielectric permittivity and breakdown strength [2, 3]. The macroscopic properties of BST ceramics are well studied, but the microstructure and morphology of the crystalline phase are insufficiently investigated.

In this work, the microstructure and surface morphology of glass ceramics based on $(Ba_{0.75}, Sr_{0.25})TiO_3$ doped by Mn with composition $25.95BaO–8.65SrO–(29.4\text{-}x)TiO_2–22SiO_2–12Al_2O_3–2BaF_2–xMnO_2$ (x = 0-0.5 mol.%), prepared from melted and quenched mixed powders. The as-quenched glass was annealed and subjected to controlled crystallization in air for 2 h in temperature range from 850 to 950 °C.

Microstructure study of the polished surface BST-Mn samples using scanning electron microscopy revealed dendritic clusters of crystalline phase with sizes from 3 to 6 μm in ceramic annealed at 850 °C with width of individual branch below 100 nm. The crystalline phase has a dense branching morphology formed by isotropic growth and tip splitting.

Value of fractal dimension obtained by box counting D = 1.96 sufficiently high than for DLA cluster (D = 1.70) [4]. In studied samples BST-Mn-850 °C with different amount of Mn were obtained close values of the fractal dimension.

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