Effect of Nonstoichiometry on the Microstructure and Dielectric Properties of Strontium Titanate Ceramics

A. Tkach, P.M. Vilarinho, A.M.R. Senos, A.L. Kholkin

Department of Ceramics and Glass Engineering, CICECO, University of Aveiro, 3810-193 Aveiro, Portugal

Defect chemistry in $BaTiO_3$ ceramics has been considerably studied due to its practical importance as ferroelectric and piezoelectric material. However, it is less studied in $SrTiO_3$ (and $SrTiO_3$ based materials), despite its current interest as promising candidature for tunable microwave application and dynamic random access memories (DRAM). The relationship between Sr/Ti ratio, the microstructure and the dielectric properties is not well known. In this study the effect of Sr/Ti ratio on the structure, microstructure and dielectric properties of $SrTiO_3$ ceramics is analysed. Nonstoichiometric strontium titanate ceramics were synthesised by solid state reaction. Microstructure development and grain size growth was examined by XRD, SEM and dilatometric analysis. The dielectric properties were evaluated as a function of temperature and frequency in the low frequency range. The lattice parameter was found to slightly decrease and the grain size to decrease dramatically with the Sr/Ti increasing > 1. The Ti excess compositions have higher dielectric permittivity then stoichiometric ceramics and possess almost the same loss. On the other hand Sr excess compositions exhibit much lower loss, corresponding to lower dielectric permittivity comparing with stoichiometric ST ceramics.