

## VARIABLE TEMPERATURE STUDY OF $\text{CaBi}_4\text{Ti}_4\text{O}_{15}$ AND $\text{Ca}_{0.5}\text{Bi}_{4.5}\text{Ga}_{0.5}\text{Ti}_{3.5}\text{O}_{15}$

V.G.Vlasenko, I.A.Zarubin, E.V. Vlasenko, A.T.Shuvaev, K.G. Abdulvahidov  
*Institute of Physics, Southern Federal University, 344090, Stachki Ave. 194, Rostov-on-Don, Russia*

The Aurivillius family of bismuth-layered oxides have been the subject of extensive study for applications as nonvolatile computer memories, high-temperature piezoelectric transducers and oxygen ion conductors. The structure of the Aurivillius phases (APs) with general chemical formula  $\text{A}_{m-1}\text{Bi}_2\text{B}_m\text{O}_{3m+3}$  consist of  $[\text{Bi}_2\text{O}_2]^{2+}$  layers regularly interleaved with  $m$  perovskite-like  $[\text{A}_{m-1}\text{B}_m\text{O}_{3m+1}]^{2-}$  slabs. The 12-fold coordination A-sites of perovskite blocks are typically occupied by large cations such as  $\text{Bi}^{3+}$ ,  $\text{Ca}^{2+}$ ,  $\text{Sr}^{2+}$ ,  $\text{Ba}^{2+}$ ,  $\text{Pb}^{2+}$ ,  $\text{Na}^+$ ,  $\text{K}^+$ ,  $\text{Th}^{4+}$  and *ets.* and the 6-coordinate perovskite-like B-sites by smaller cations such as  $\text{Ti}^{4+}$ ,  $\text{Nb}^{5+}$ ,  $\text{Ta}^{5+}$ ,  $\text{W}^{6+}$ ,  $\text{Fe}^{3+}$ ,  $\text{Mn}^{4+}$ ,  $\text{Cr}^{3+}$ ,  $\text{Ga}^{3+}$ . In this work we present a detailed variable-temperature XRD and dielectric study of APs with  $m=4$   $\text{CaBi}_4\text{Ti}_4\text{O}_{15}$  (CBT) and  $\text{Ca}_{0.5}\text{Bi}_{4.5}\text{Ga}_{0.5}\text{Ti}_{3.5}\text{O}_{15}$  (CBT:Ga). CBT and CBT:Ga were prepared by traditional solid state reaction. The X-ray diffraction patterns of CBT and CBT:Ga were analyzed by the Rietveld method. At temperatures below the ferroelectric Curie temperatures  $t_c$  both compounds crystallize in the polar orthorhombic space group  $A2_1am$ . The refined structural parameters at room temperature for CBT and CBT:Ga are  $a=5.4231(8)$  Å,  $b=5.3973(1)$  Å,  $c=40.674(4)$  Å and  $a=5.4616(2)$  Å;  $b=5.4102(1)$  Å;  $c=40.9001(2)$  Å, respectively. The temperature dependence of the structure CBT and CBT:Ga was investigated between 24 and 750°C and the variation of the lattice parameters as a function of temperature is shown in Fig.1.

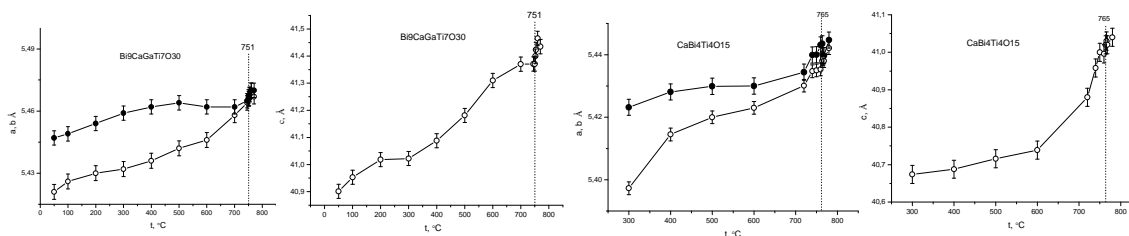


Fig.1 Variation in the lattice parameters for CBT:Ga (left panels) and CBT (right panels) as a function of temperature.

At temperatures above the ferroelectric  $t_c$  ( $t_c=765^\circ\text{C}$  for CBT and  $t_c=751^\circ\text{C}$  for CBT:Ga) the structures transforms to the tetragonal centrosymmetric space group  $I4/mmm$ .

The dielectric properties of APs were investigated in the frequency range of 25Hz-1MHz and the temperature range of  $25^\circ\text{C}$ -  $900^\circ\text{C}$ . The temperature dependences of dielectric constant at different frequencies for CBT and CBT:Ga exhibits a sharp peaks, which indicates that these compounds have a normal ferroelectric-paraelectric phase transformations at  $t_c$  obtained from variable-temperature XRD data.