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Preface

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CERAMIC COMPOSITES

1D nanostructured materials (1D perovskites) and enables the modification of the optical, electrical and magnetic properties of titanate-based 1D nanostructures. In particular, the modification of titanate-based 1D nanostructures by the transition metals is of great interest due to the possible applications of as-modified nanostructures in photocatalytic processes, waste-water purification and catalysis.

We synthesized one-dimensional, nanostructured alkaline titanates by the hydrothermal treatment of crystalline TiO_2, anatase in a 10-M NaOH solution at various temperatures and for various times. The modification of the hydrothermally synthesized 1D nanostructures was performed under ambient and hydrothermal conditions. For the characterization of the crystal structure, the morphology and the composition of the products we used x-ray powder diffraction and transmission electron microscopy (HRTEM, EDS, and electron diffraction).

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ELECTRICAL PROPERTIES OF BARIUM BISMUTH TITANATE

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Family of bismuth oxides was discovered more than 50 years ago by Aurivillius [1]. Recently, there has been renewed interest in the properties of the Aurivillius phases as temperature-stable ferro-piezoelectrics [2]. Several bismuth-layered crystal structures and their properties have been investigated in detail. However, a lot of aspects of the preparation and properties of barium bismuth titanate, $BaBi_4Ti_4O_{15}$ [BBiT] remain unexplored, whereas being promising candidate for high-temperature piezoelectric applications, memory application and ferroelectric nonvolatile memories (Fe-RAM).

	T_c (°C)	$\Delta T_{relaxor}$	ε	$\tan\delta$	γ
BBiT - 1	417 - 402	15	1188-1546	~ 0.07	1.97

In present work, BBiT was prepared by solid state reaction from mixture of oxide: BaO, TiO_2 and Bi_2O_3 which was, previously, milled for 6 h. Mixture was heated at 750°C for 4 h and after that sintered at 1130°C for 1 h. The values of T_c, dielectric constant (ε), the loss tangent ($\tan\delta$), degree of relaxation behavior ($\Delta T_{relaxor}$) and degree of diffuseness of the material (γ) are summarized in Table below. The degree of relaxation behavior is found to be only 15 K, which suggests the shift of Tc with frequency is not much distinct in BBiT ceramics. A modified Curie-Weiss relationship is used to study the diffuseness behavior of a ferroelectric phase transition where value of γ indicates the degree of diffuseness of BBiT material. The dielectric relaxation rate foollow the Vogel-Fulcher relation with activation energy = 0.013eV, relaxation frequency = 2.09×108 Hz, and freezing temperature = 378°C. All this parametars indicate that BBiT is a relaxor ferroelectric.

References

[1] Aurivillius, B., *Arkiv. Kemi.* **1** (1949) 499-512.
[2] Tellier, J., Boullay, Ph., Manier, M., Mercurio, D., *J. Solid State Chem*, **177** (2004) 1829-1837.

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HIGH TEMPERATURE REACTIONS IN $ZrSiO_4$-Al_2O_3 SYSTEM

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The mullite-zirconia composite possesses high fire and hest shock resistance as well as good mechanical and chemical resistance at high temperatures. In this work solid state reactions between $ZrSiO_4$ and Al_2O_3 beaching to formation of mullite and zirconia composite material have been investigated. The oxide composition was specified according to a stoichiometry of the reaction equation $3Al_2O_3+2ZrSiO_4 \rightarrow 3Al_2O_3 \cdot 2SiO_2 +ZrO_2$. Data were obtained at temperatures ranging from 1400°C to 1600°C for a period of reaction time ranging from 30 minutes to 60 hours. Samples were examined with X-ray diffraction and electron scanning microscopy with energy dispersive X-ray analysis (SEM+EDX). Obtained results indicates that the first stage of the reaction is decomposition of $ZrSiO_4$ into oxide components, then a two-way diffusion of Si^{+4} and Al^{+3} ions goes on followed by nucleation and crystalline mullite grows. Reaction rate at the temperature 1500°C is very low. Decomposition of $ZrSiO_4$ is the fastest stage of reaction at the temperature of 1600°C.

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BARIUM TITANATE THICK FILMS PREPARED BY SCREEN PRINTING TECHNIQUE

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Pure and doped with lanthanum and antimony barium titanate ($BaTiO_3$-BT, BTL and BTS) powders were prepared by the polymeric organometallic precursors method (Pechini process-PPM) starting from citrate solutions.

For the preparation of thick films was used screen printing technique. The paste was prepared from suspension of organic material (resin, organic solvent and additives to improve rheological behavior of paste) and barium titanate powders obtained by Pechini procedure, using a ratio 30:70. To get better adhesion between paste and substrate it was added a low temperature melting glass in powder form. The electrodes were prepared from the silver/palladium mixture (Ag/Pd – 70/30). The bottom electrode was deposited on the Al_2O_3 support and in the middle was screen-printed dielectric layer of (1) pure barium titanate, (2) barium titanate doped with 0.3 mol% La or (3) barium titanate doped with 0.3 mol% Sb. On the top was deposed the upper electrode. The layer-sandwich was sintered at 850°C during 1h in air flow atmosphere.

Measurements of thickness and roughness of barium titanate thick films (BT, BTL and BTS) were performed as well as electrical measurements such as dielectric constant and dielectric losses vs. temperature. The value of dielectric constant was very low and the possible reason could be that the electrode material could diffuse from the surface of BT layer through intergranular pores and affect on changing the dielectric properties of films. This measurement also can point out that dopants may have the influence on dielectric constant. Dopants in this case are decreasing dielectric constant value. Measurement of hysteresis was also performed.

Reference

[1] B. D. Stojanović et al. Electrical properties of screen printed $BaTiO_3$ thick films, *J Eur Ceram Soc* **24** (2004) 1467-1471.