VERSITA

Chemical Papers 67 (10) 1311–1316 (2013)
DOI: 10.2478/s11696-013-0394-9

ORIGINAL PAPER

Influence of the B-site cation nature on dielectric properties of Ca_2XBiO_6 (X = Dy, Fe, Al) double perovskite

[a]Simona Feraru, [a,b]Petrisor Samoila, [c]Valentin Nica, [a]Alexandra R. Iordan, [a]Mircea N. Palamaru*

[a]*Faculty of Chemistry,* [c]*Faculty of Physics, Alexandru Ioan Cuza University, Iasi, 700506, Romania*

[b]*Petru Poni Institute of Macromolecular Chemistry, Iasi, 700487, Romania*

Received 10 December 2012; Revised 12 February 2013; Accepted 15 February 2013

For the synthesis of Ca_2XBiO_6 (X = Dy, Fe, Al) metal oxides with ordered double-perovskite structure, the sol–gel auto-combustion method has been used for the first time. The synthesis progress was followed by the Fourier transform infrared spectroscopy and the samples structure was investigated by X-ray diffraction. The samples morphology was studied by means of scanning electron microscopy. The influence of the nature of the trivalent B-site cation on the dielectric properties was evaluated by resistivity measurements in vacuum at frequencies between 10^2–10^5 Hz. The best dielectric behavior was obtained for Ca_2AlBiO_6 and Ca_2DyBiO_6, while the best semiconductor behavior was found for Ca_2FeBiO_6.

Keywords: sol–gel auto-combustion, double perovskite, dielectrics, semiconductors

Introduction

Metal oxides with the double-perovskite structure $A_2BB'O_6$ (A = alkaline earth and B,B' = magnetic or nonmagnetic metal ions) were studied intensively especially due to their properties such as: half-metallic nature (Bonilla et al., 2007), high magnetoresistance at room temperature (García-Landa et al., 1999), dielectric properties (Nair et al., 2012). Therefore, these compounds are employed for various applications: catalysis (Yamazoe & Teraoka, 1990), photocatalysis (Hatakeyama et al., 2010), SOFC's materials (Marrero-López et al., 2010). Nevertheless, a few studies on the double perovskite with B' = Bi were reported. In this respect, compounds with the general formula of $A_2Fe^{3+}B'O_6$, where A = Ca, Sr, Ba, and B' = Sb, Bi, were studied by Macquart and Kennedy (2005) and Lee et al. (1997) due to their antiferromagnetic behavior. Also, the solid-state synthesis, structural characterization, and magnetic properties of the series of double-perovskite polymetallic oxides Ba_2MBiO_6 (M = from Ce to Lu) was reported by Harrison at al. (1995). Most often, the synthesis of this kind of compounds is achieved by the solid state reaction route (Shaheen & Bashir, 2010), which is a relatively simple but ineffective technique due to the higher energy consumption of the procedure and a longer reaction time than that afforded by the wet-chemistry-based techniques.

In order to improve the properties of double perovskites and to obtain the appropriate products for different applications, various synthesis techniques such as sol–gel (Bruncková et al., 2012), hydrothermal (Wu et al., 2010), or co-precipitation (Jacobo, 2005) have been developed. Among these methodologies, sol–gel and its variants, including sol–gel auto-combustion, has been shown to have great potential in the preparation of metal oxides with the perovskite structure for advanced applications (Blosi et al., 2009).

The aim of this work was to obtain a series of double perovskite-type oxides with the general formula of

*Corresponding author, e-mail: palamaru@uaic.ro