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Preparation and Study of Bismuth Rare-Earth Tungstate Composite Screen-Printed Thick Films

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In this paper, we report the microstructural and dielectric properties of bismuth rare-earth tungstate composite screen-printed thick films ($BiGd_{1-X}Nd_XWO_6$, $BiGd_{1-X}Y_XWO_6$, and $BiY_{1-X}Nd_XWO_6$). The crystal structure of $BiREWO_6$ (RE = Gd, Nd, and Y) can be associated with the Bi_2WO_6 perovskite structure. It was observed that the crystalline structure was attributed to a monoclinic phase with space group *A12/m1*. $BiYWO_6$ and $BiY_{0.5}Gd_{0.5}WO_6$ films showed characteristics of the dielectric relaxation phenomenon. The thick films exhibited moderate dielectric permittivity (ε_r') values from 10 to 42. The results showed that the obtained ε_r' values for films can be useful for capacitor applications and certainly for microelectronics and microwave devices (mobile phones, for example), where miniaturization of devices is crucial.

Key words: Bismuth rare-earth tungstate, dielectric measurement, thick films, electroceramic

INTRODUCTION

The diversity of perovskite-structure compounds,[1–3] which can be synthesized by several methods, provides an ample range of electrical, magnetic, optical, and mechanical properties over a wide temperature range; For example, Bi_2WO_6 is known for exhibiting three polymorphic phases as a function of temperature.[4,5] It is a well-known ferroelectric with the Aurivillius structure, with a high Curie temperature (T_c) of around 950°C.[6] Its perovskite block consists of an infinite two-dimensional array of corner-linked WO_6 octahedra. The Aurivillius family of layered bismuth oxides, one of the most important classes of ferroelectric materials, has been extensively studied, in particular for their potential in information storage systems.[7]

In previous studies,[8] the $BiREWO_6$ (RE = rare earth) system, a parent compound of Bi_2WO_6, was used to build a dielectric resonator monopole antenna to be used at microwave frequencies. However, there are few reports on $BiREWO_6$ being used as an electronic device material. In general, it is synthesized by a solid-state ceramic route and exhibits interesting dielectric properties.[9] However, there is not a specific application of this material as a transducer, sensor, capacitor or inductor for use in hybrid circuits. A reasonable number of applications require films of microns to tens of microns. Whereas ferroelectric thin-film methods have their specific features, ferroelectric thick-film processing is closer to that of bulk ceramics, including powder synthesis, powder processing, coating, and sintering; For example, lead zirconate titanate [$Pb(Zr_{1-X}Ti_X)O_3$,

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