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Grating-patterned $Bi_{0.85}La_{0.15}Fe_{0.95}Mn_{0.05}O_3$ epitaxial thin film prepared using photosensitive sol-gel method and its ferromagnetic and ferroelectric properties

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Abstract: $Bi_{0.85}La_{0.15}Fe_{0.95}Mn_{0.05}O_3$ (BLFMO) gel films with benzoylacetone (BzAc) as a chelating reagent were fabricated on (00*l*) $LaAlO_3$ (LAO) substrates using a photosensitive sol-gel method. The morphology, crystalline structure, electric and magnetic properties, and the grating-pattern of the films were investigated. The results showed that the epitaxial BLFMO films deposited on LAO single crystal substrates exhibit a higher degree of the c-axis orientation. The remnant polarization and saturation magnetization were found to be higher than those of the randomly oriented BLFMO films. Moreover, the gratings of the film with a period of 1 μm were obtained after exposure to two interference laser beams followed by leaching in ethanol. After treatment at 600°C, the gel film turned into inorganic film gratings.

Keywords: C-axis oriented films; Laser interference; Magnetoelectric films; Saturation magnetization; Remnant polarization.

1. Introduction

$BiFeO_3$ (BFO), a rhombohedrally distorted perovskite-structured material with R3c space group, possessing ferroelectric order (Tc≈1103K) and G-type anti-ferromagnetic order (T_N≈643K), is known to be the only single-phase material that shows multiferroic properties at room temperature. It attracted a great interest due to potential applications in the fields of electronics, spin valves, transducers, multiple state memory devices, and microelectromechanical systems [1-5]. The key issue towards applications is the preparation of BFO with high quality resulting in good