BST ferroelectric thin films deposited by sol-gel : correlations between microstructural and electrical characterizations

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Abstract

Ferroelectric thin films have a great potential for applications in electronics and in particular in microwaves. In this view, the aim of this work is to deposit and characterize BST films in order to find correlations between their microstructural and electronic properties. The studied BST material is Ba0.8Sr0.2TiO3 which is ferroelectric at room temperature. We have deposited by sol-gel BST films of different thicknesses on various substrates such as silicon, sapphire, LaAlO3. The sol-gel deposition method is a classical process starting with barium and strontium acetate. These precursors are dissolved in acetic acid at 80C and then titanium isopropoxide is added and stirred at 60C during 2 hours. The BST gel obtained is then deposited by spincoating onto the substrate and heated 1mn at 300C on a hot plate. These operations are repeated to increase the thickness of the film and followed by a thermal treatment at 750C under air during 1 hour. The microstructure of the as-deposited films has been characterized by non destructive methods. Ellipsometry permits to evaluate the thicknesses of the BST film. It has been determined that the thickness of a single layer is about 10 nm in our deposition conditions. X-ray diffraction pattern shows a lot of peaks which are characteristics of a polycrystalline sample. The lattice parameter value is 0.398 nm, in good agreement with the BST composition. SEM and AFM microscopies were used to investigate the surface of the films. The SEM observations have not shown visible defects. The AFM permits to evaluate the roughness on 10x10 m areas : the rms value obtained is 3 nm for a 500 nm thick film. We have investigated the electrical properties of the BST films in a large frequency range thanks to interdigitated capacitors. For example, for a 300 nm thick film, the complex permittivity is constant in a first approximation up to 1 GHz with εr≈500 and tgδ≈0,012.