BaTiO₃–CoFe₂O₄–BaTiO₃ trilayer composite thin films prepared by chemical solution deposition

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Abstract

Multiferroic BaTiO₃–CoFe₂O₄–BaTiO₃ thin films were synthesized by spin coating of Co(NO₃)₂ – Fe(NO₃)₃ and Ba(OAc)₂ – Ti(*i*-OPr)₄ solutions in a solvent mixture of acetic acid and dimethylformamide. Subsequent stepwise thermal treatment at 200, 400 and 800 °C leads to the desired ferroelectric and ferrimagnetic phases. The phase formation process was monitored by thermogravimetric, XRD, IR and Raman measurements. SEM was used to characterize the layered sandwich structure and the thickness of each layer. Two samples with different thicknesses of the perovskite and spinel layers are discussed. Sample 1 consists of a 120 nm layer of CoFe₂O₄ between two 70 nm thick BaTiO₃ layers. For sample 2 the 90 nm thick top and bottom layers of BaTiO₃ are enclosing a 220 nm CoFe₂O₄ layer. The quality of the samples surfaces was determined by AFM leading to root mean square roughness values of about 4 nm. Magnetic investigations reveal a slightly anisotropic behavior for in-plane and out-of-plane magnetizations and coercivities. Polarization measurements show hysteresis loops (maximum P_S = 29 μC cm⁻²; maximum P_R = 17 μC cm⁻²) with pronounced switching peaks at the corresponding coercive fields of 200 and 360 kV cm⁻¹, respectively.