Evaluation of the structural phase transition in multiferroic (Bi1-x Prx)(Fe0.95 Mn0.5)03 thin films by picosecond acoustic interferometry

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Picosecond acoustic interferometry (PAI) is an experimental technique for the generation and detection of ultrashort acoustic pulses using ultrafast lasers [1]. It provides opportunity to monitor propagation of nanometers-in-length acoustic pulses in transparent media and to determine acoustical, optical and acousto-optical parameters of the materials [2]. We report on the application of PAI for the evaluation of the effect of Pr substitution on the elasticity of Bi(Fe0.95Mn0.05)O3 (BPFMO) thin films. The films were deposited on Si and LaAlO3 substrates by a sol-gel method. X-ray diffraction and Raman spectra revealed earlier that a phase transition from rhombohedral to tetragonal structure occurs at about 15% Pr substitution and is accompanied by the maxima of remanent magnetization and polarization [3]. Thus BPFMO films at the structure transition composition show the strongest ferromagnetism. Combining PAI with optical interferometry, scanning electron microscopy and topographic measurements by atomic force microscopy we found that the structural transition is also characterized by the minimum in longitudinal sound velocity and maximum in optical dielectric constant. Our results in combination with earlier ones [3] suggest that BFO-based films and ceramics with compositions near phase boundaries might be promising materials for multifunctional applications. The authors acknowledge Le Mans Acoustique for funding "Ferrotransducers" project.

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