**Elastic and Magnetic Properties of Tb-MnO Based Thin Films**

G. Mwendwa,1 D. Wamwangi,1 B. Mathe,1 L. Kotane,1 R. Erasmus,1 D. Billing,2 A. Shnier,2 and M. Madhuku3

1School of Physics, Material Physics Research Institute, University of the Witwatersrand, Johannesburg, Private Bag 3, 2050 WITS, South Africa

2School of Chemistry, Molecular Sciences Institute, University of the Witwatersrand, Johannesburg, Private Bag 3, 2050 WITS, South Africa

3iThemba LABS (Gauteng), Private Bag 11, Johannesburg, WITS 2050, South Africa

**Abstract**

Multiferroic materials are a class of materials exhibiting correlations in their ferroic orders. Light interaction with lattice vibrations is a powerful method to study the elastic properties of solids using surface Brillouin scattering (SBS). SBS is based on the inelastic scattering of photons by acoustic modes (phonons) to determine the elasticity of materials. In this work, ferroelastic and magnetic properties of rare-earth complex oxides thin films are investigated. The phonon velocities were measured at room temperature using a solid-state laser (λ=532 nm) at an incidence angle of 60o. The measured data was optimized and fitted with data simulated using surface elastodynamic Green’s function for discrete phonon dispersion in the k||d range of 0–5. By the least-squares fitting approach, we obtain the uncertainties of measurement from Taylor series expansion of the phonon phase velocity dependence on the primary elastic constants (C11 and C44), yielding the optimum values as C11 = 180±4.90 GPa, and C44 = 43±0.89 GPa. The films were isotropic and so using Cauchy’s relation (C12 = C11-2C44), C12 was obtained as 94 GPa. From this set of elastic constants, the derived moduli were obtained as follows: Young’s modulus (*E*) = 116 GPa, Shear modulus (*G*) = 43 GPa, Bulk modulus (*B*) = 123 GPa, Cauchy pressure (C12-C44) = 51 GPa Poisson’s ratio (*v*) = 0.34, and Pugh’s ratio (*B/G*) = 2.85. On the other hand, the magnetic properties of the films have been studied by vibrating sample magnetometry (VSM). The films have exhibited ferromagnetic ordering at T<150 K. A spin-glass-like behaviour associated with competing ferromagnetic and antiferromagnetic magnetic ordering has also been observed at T~50 K from isofield measurements.

**Keywords:** Multiferroics, phonon dispersion, ferromagnetism, spin-glass.