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THICKNESS DEPENDENCE OF THE MAGNETO ELECTRIC PROPERTIES IN $BiFeO_3$ THIN FILM

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Abstract – The effect of thickness on the magnetic behavior of $BiFeO_3$ thin films was discussed. Films of different thicknesses were grown on $Pt/TiO_2/SiO_2/Si$ substrates. The films were deposited by an RF sputtering technique at high-oxygen pressures. The grain boundary microstructure was analyzed via Atomic Force Microscopy (Inset Fig. 1).Using a dynamic lock-in technique is study the coupling between magnetic and ferroelectric properties in $BiFeO_3$ film (Fig 1 and Fig. 2). The ME Coefficient behavior as a function of thickness indicates an increase in the spiral structure of spin with increased thickness[1].

Materials that have coupled electric, magnetic, and structural order parameters that result in simultaneous ferroelectricity, ferromagnetism, and ferroelasticity are known as multiferroics[2]. These compounds present opportunities or potential applications in information storage, the emerging field of spintronics, and sensors. Perovskite $BiFeO_3$ has attracted much attention due to the coexistence of ferroelectric and magnetic orders. $BiFeO_3$ thin films of different thicknesses were grown on $Pt/TiO_2/SiO_2/Si$ substrates by using a magnetron sputtering technique assisted by radio frequency in a pure oxygen atmosphere and a deposition rate of 1, 1.5, 2 and 2.5 hours. AFM images show grain size increase as film thickness increases, according to a diffusion growth model. We also using a dynamic lock-in technique is study the coupling between magnetic and ferroelectric properties in $BiFeO_3$ film. This multiferroic comportment is also revealed in our previous results for bulk material[3]. Unlike the response in the bulk material is reached saturation value. The saturation values decrease with increasing thickness of the films. The behavior of the ME coefficient with the thickness can be interpreted in terms of the spin structure which decreases with thickness, possibly due to constraints or enhanced Anisotropy causing an increase in the value of ME coefficient.

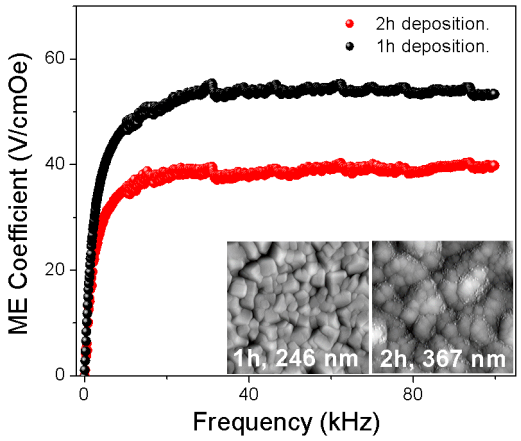

Figure1. Transverse ME coefficient on $BiFeO_3$ films, Inset: AFM images of the surface (3μm×3μm).

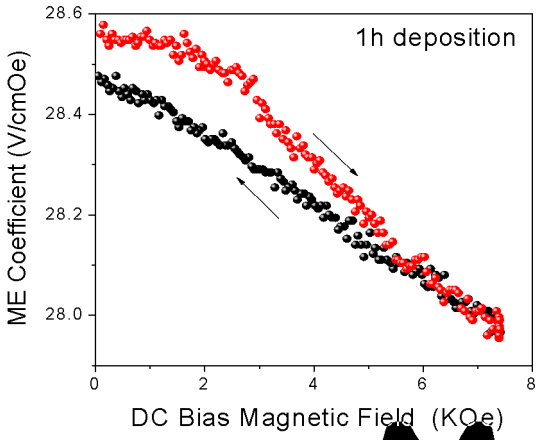

Figure2. DC magnetic field dependence of ME coefficient at 7 kHz, T=300K.

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