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Ferroelasticity of EuTiO3 and TbMnO3 Thin Films on (001) Si

$EuTiO_3$ and $TbMnO_3$ are perovskite rare-earth-transition metal-based oxides hosting multiple ferroic order states (multiferroics). Ferroic ordering refers to the spontaneous alignment of ferroic orders due to an applied stimulus, like magnetic or electric fields. The three primary ferroic orders are ferromagnetism (spontaneous spin ordering), ferroelectricity (spontaneous charge ordering), and ferroelasticity (spontaneous strain). This work studies the ferroelasticity of $EuTiO_3$ and $TbMnO_3$ thin films under a finite magnetic field to determine the correlation between the spin and lattice electronic degrees of freedom in these materials at room temperature.
Surface Brillouin scattering (SBS) of light is investigated in $EuTiO_3$ and $TbMnO_3$ thin films deposited on (001) Si at k||d in the range of 0 to 5. These perovskite oxide films could exhibit magnetoelastic properties, and therefore, we explore their phonon-light interaction behavior under zero and non-zero magnetic field conditions. The magnetic responses of the films show that $EuTiO_3$ and $TbMnO_3$ are paramagnetic between 200<T<300 K and exhibit complex magnetic transitions driven by competing exchange interactions at T ~ 60, 40, and 20 K. $EuTiO_3$ and $TbMnO_3$ exhibit coupled electric and magnetic order parameters. Therefore, the findings of this study provide insights into the spin, lattice, and charge dynamics in the two materials for potential implications in advanced tunable acoustic devices and spintronics applications.

Key words: Multiferroics, perovskite, SBS, electronic degrees of freedom

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