PHONON ANOMALIES IN STRAINED $SrMnO_3$ FILMS

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Using Fourier-transformed far-infrared (FTIR) and Time Domain – Terahertz (TD-THz) ellipsometry, we investigated epitaxial thin films of $SrMnO_3$ grown by pulsed laser deposition (PLD) on various substrates.

$SrMnO_3$ in bulk is a cubic perovskite with antiferromagnetic ordering under T_N=~230-260 K. Under epitaxial strain it is possible to stabilize ferroelectric order caused by off-center displacement of the central magnetic Mn^{4+} ion [1]. Such multiferroic state is expected to show large magnetoelectric coupling. The strong interaction between the spin ordering and lattice phonons has been demonstrated on bulk $Sr_{1-x}Ba_xMnO_3$ (x = 0-0.3) [2,3].

We will present temperature dependent, 10 K – 400 K, THz-FIR optical response of 30 nm $SrMnO_3$ films with varying epitaxial strain driven by lattice mismatch of $SrMnO_3$ with respect to substrate. The substrates were chosen accordingly: cubic $LaAlO_3$ causing small compressive strain (-0.3%), tetragonal $SrLaGaO_4$ (001) with moderate 1.1% tensile strain and cubic LSAT with tensile strain of 1.8% that should be sufficient for the ferroelectric instability [4].

In our films we observe the three characteristic phonons of cubic perovskite, with dominant lowest-energy mode that shows softening with increasing strain and anomaly at temperature of the antiferromagnetic transition.

Keywords: THz ellipsometry; Ultrathin films; Ferroelectrics

References

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