Broadband Terahertz Time-Domain Spectroscopy of Ferroelectric Crystals

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The far-IR spectroscopy has been extensively applied to various kinds of ferroelectric materials to investigate IR active soft optic phonon and relaxation process of polarization fluctuations. By using the incoherent light sources, the many far-IR studies were reported on the frequency-dependent absorption, but not the real and imaginary parts of dielectric constants. The new technique of coherent terahertz generation enabled to determine real and imaginary parts of dielectric constant uniquely, and terahertz time domain spectroscopy (THz-TDS) attracted much attention. However, the most of the THz spectra until now were measured between 0.5 and 3 THz, where 3 THz is equivalent to 100 cm^{-1}(wavenumbers) [1]. Recently widely tunable monochromatic Cherenkov phase-matched terahertz (THz) wave generator was developed recently, and the frequency range of THz-TDS has been extended up to 6 THz in organic materials [2,3]. In this study, broadband THz-TDS was applied to various kinds of ferroelectric crystals from 0.2 to 6.5 THz. Both transmission and reflection spectra were measured to determine real and imaginary parts of dielectric constants in the far-IR range, and the results were shown on technologically important ferroelectric crystals such as $LiTaO_3$, $LiNbO_3$[4], $SrTiO_3$[5], and β-$Gd_2(MoO_4)_3$.

References

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