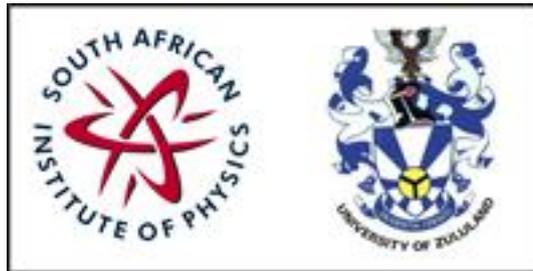


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Material characterization using Terahertz time-domain spectroscopy

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Abstract :

Terahertz time-domain spectroscopy (THz-TDS) has proven itself an invaluable tool to investigate the dielectric properties of technologically important materials non-invasively. The technique is sensitive to small changes in the complex refractive index of a material, as a result of stress or defects. In order to be able to accurately extract these sensitive material properties, experience needs to be gained by performing measurements on well-known samples. THz radiation is generated using a biased photoconductive antenna. The emitter antenna is a dipole antenna with a photo-switch. The substrate material of the antenna is low temperature grown GaAs, which has an extremely short (200fs) carrier lifetime. Due to this short carrier lifetime, the antenna will undergo only a single oscillation when triggered by a femtosecond laser pulse and emit a single oscillating pulse of terahertz radiation. To measure the THz pulse, a duplicate unbiased antenna is used as receiver. The receiver is again triggered by a femtosecond laser pulse, generating charge carriers. These charge carriers are accelerated by the electric field of the incident THz pulse. Since the life time of the charge carriers are so short, only a specific portion of the incident electric field is measured. By repeating the measurement for different relative arrival times of the trigger pulse (femtosecond pulse) with respect to the THz pulse, the THz pulse is mapped out in time. The measurement of the electric field of the THz pulse contains both amplitude and phase information and hence information about the real and imaginary parts of the sample's refractive index. As examples, we will look at polyethylene, which is nearly transparent in the terahertz regime, and sapphire, which is birefringent in the terahertz regime. Future work, which entails the construction of a THz time domain spectrometer for measurements in reflection, will also be discussed.

Award :

Yes

Level :

MSc

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Paper :

No

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