

Characterising Electromagnetic Materials to Terahertz Frequencies using Vector Network Analyzers

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Abstract

This lecture describes an initial assessment of a commercially available THz material characterization kit (MCK). The assessment is based on the measurement of several material samples. The MCK comprises two conical waveguide horn transitions and two sections of low-loss corrugated waveguide. A gap between the two corrugated waveguides allows the material samples to be inserted into the system during measurement. The MCK is attached to a THz Vector Network Analyser (VNA), which measures S-parameters, in the frequency domain, of a material under test (MUT). A computer-based algorithm employing an iterative calculation derives values for material parameters (e.g. permittivity) from the measured S-parameters of the MUT. A MCK is evaluated over the frequency range 0.75 THz to 1.1 THz, to assess the plausibility of results that can be obtained using such a technique. Two VNAs utilizing frequency extender heads were used for the investigation, with measurements being made with reference to a range of different calibration techniques and different calibration standards. Whilst some of the results obtained look reasonable, a significant proportion of the results were either difficult to interpret or showed inexplicable (i.e. non-physical) behaviour. This indicates that much work is still needed before this technique can be used routinely for the measurement of material parameters at these very high frequencies.

This lecture is based on an invited lecture that was given at the Dielectrics 2017 conference (organised by the Institute of Physics), which took place at the National Physical Laboratory, Teddington, UK, in April 2017.