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3D printable materials for use in dual band optical structures

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Pursuit after new technical and scientific achievement is a driving force for new solutions in research equipment. Furthermore, highest ever competition is pushing time of rapid development to the limits. Evolution of science lead us to a place where two or more IR radiation wavelengths are necessary to conduct some experiments. In some cases wavelength separation is significant, mixing one from THz range and other from NIR of MIR. Working with whole IR spectrum is possible with usage of reflective optics. Inconvenience occurs when one have to work with THz range, where optical elements are significantly bigger. The 4" mirrors are standard and even 8", or bigger elements aren't uncommon. This fact may impact experimental setup layout and in cases of facilities like free electron laser, where two wavelength operation is associated with doubling beam guiding installation, simplifying even a part of it may be desirable. Guiding both THz and MIR can be done when using only reflective optics, but there is very limited Materials that can be usable for manufacturing a passive optical elements that work in both bands could lead to reduction of the number of elements. That can translate to experiment optimization, reduce cost of elements and shorter time of preparing experimental setup.

In these study selection of materials suitable for manufacturing of optical 3D structures was presented. A number of samples with different thickness was prepared and measured. The issue of the characterization of various materials in wide, optical spectral range is a common day task, unless material itself behaves differently in situations when it is homogeneous and when it is formed in the 3D printing process.

First, samples were measured in THz range with the Time domain spectroscopy (TDS) in 0.3-2.5 THz (1 mm – 150 um) frequency band. Transmission of the materials was measured and attenuation coefficients were determined. Spectral characterization of the samples in the range from 2 THz up to 1.5 um was conducted with FTIR spectroscopy. Based on this set of results influence of 3D print on the spectrum was shown. Discussion of the results includes influence of different polarization used in measurements, effects occurring with samples of different thickness and 3D printing side effects.

The objective is to enable designing of the optical elements using spectral properties of material combined with curvatures of the element. Design of optics that can work differently on two spectral bands takes advantage of implementing additional features like wavelength selectivity in THz band or different focal points.

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