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Polarisers for sub-terahertz range made with 3D printing technique

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Terahertz (THz) radiation is currently of high interest, due to its non-ionizing properties and innovative applications. At the same time, the methods of 3D printing in recent years have development significantly, allowing easier and more cost-effective production of passive optical components.

Motivated by these advances, we demonstrate the possibility of manufacturing polarisers, created using the fused deposition modelling (FDM) technique [1] for sub-THz radiation range. In Fig. 1 a photograph of the designed polarizer is shown. Different materials were used to manufacture polarisers and were investigated preliminary in time domain spectroscopy system (THz-TDS) and then different polarisers were investigated. The examination focused on polarisers made from different materials and with different fill factors (FF).

Fig. 1 Photograph of 3D printed polariser made of polyethylene terephthalate glycol PETG (MDT) ferromagnetic composite.

The experimental evaluation consisted of two ways to validate the accuracy and performance of the 3D printed THz components. In the first method, the focus was put on evaluating the performance of the polarisers based on their angular position relative to the source and detector in the optical setup. Part of the results is shown in Fig. 2. In the second setup, the emphasis was placed on analyzing three angular positions of 0, 45 and 90 degrees for different frequencies. To determine the range of working frequencies, the scans were carried out using terahertz spectroscopy (TDS) in the frequency range from 0.15 THz to 0.5 THz. Thus, the polarisers designed for 95 THz frequency are properly working up to 0.4 THz.

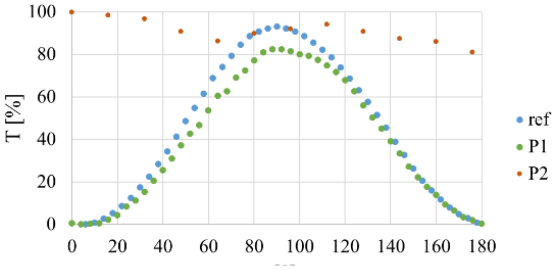

Fig. 2 Normalised diagram presenting the transmitance dependance on angular position of polarisers: ref - the commercial wire grid polariser (WGP), P1 - 3D printed polariser made of polyethylene terephthalate glycol (PETG) composite with carbon fibre additive, P2 - 3D printed polariser made of PETG (MDT) with ferromagnetic composite.

REFERENCES

[1] KALUZA, Mateusz, et al. THz optical properties of different 3D printing polymer materials in relation to FTIR, Raman, and XPS evaluation techniques. In: 2022 47th International Conference on Infrared, Millimeter and Terahertz Waves (IRMMW-THz). IEEE (2022). p. 1-2.