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Shielding with Graphene Epoxy Composites in the Extended THF Band from 0.25 to 4.00 THz

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We report on THz characterization of graphene composites in the extended THF band from 0.25 to 4.00 THz. The composites, containing low percent by weight fractions (wt.%) of graphene form 0.8wt.% to 1.2wt.%, were investigated using THz- Time Domain Spectroscopy (THz-TDS). Based on the measured transmission and reflection coefficients, the shielding effectiveness parameters of reflection (SER) and transmission (SET) were calculated to determine the shielding effectiveness of absorption (SEA). The procedure comprised each of the weight fractions of graphene.

While the SER was found to be less than ~0.6 dB within the measured frequency range and for all the samples, the SET and SEA were found to be substantially higher, firmly above ~70 dB with graphene loading of 1.2wt.% at the frequency f=1.6 THz. Such unexpectedly high total shielding effectiveness resulted mostly from absorption, due to the measured low absolute values of SER.

The fact that a simple EM energy redirection via conduction-based reflection was not primary energy loss mechanism is favorable from the point of view of EMI shielding because contrary to metal-based conducting coatings or metallic nanocomposites, the graphene-based epoxy materials do not spread unwanted EM radiation from one place to another. Additionally, they have low weights.

By performing the Beer-Lambert calculations, we show that even a thin-film or a spray coating with a thickness in the few-hundred-micrometer range of lightweight, not conducting and not reflecting graphene epoxy composites can be sufficient for blocking THz radiation in many practical applications, where the shielding of EM by ~20–30 dB is typically sufficient. Thus, the fabricated composites can be successfully used as effective ultra-thin stealth materials.

[1]. Z. Barani, K. Stelmaszczyk, et al., Appl. Phys. Lett. 120, 063104 (2022)

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