Optical properties of nanocomposites based on various 2D materials in terahertz regime

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The unceasing need for faster electronics and wireless data transfer combined with the development of sensing and emitting devices in the THz regime has caused the industry to shift to the THz regime – usually described as a range of frequencies between 0,1 and 10 THz.
However intriguing, the THz regime is still poorly explored, compared to other frequency ranges. To ensure the proper operation of delicate electronic devices in the THz regime, a material capable of shielding any undesirable radiation is needed. The ability to attenuate any electromagnetic interference (EMI) is called the shielding effectiveness or SE. Shielding effectiveness depends on many cross-linked variables and is based on three main mechanisms – reflection, internal reflection, and absorption of incident radiation.
In this work we study the terahertz optical properties of a series of polymer composites based on various 2D materials, like graphene, MXenes and hBN. We investigate the main shielding mechanisms of said composites and as a result show a highly absorbing (>40dB) graphene composite with low reflectance (<5%).

Figures

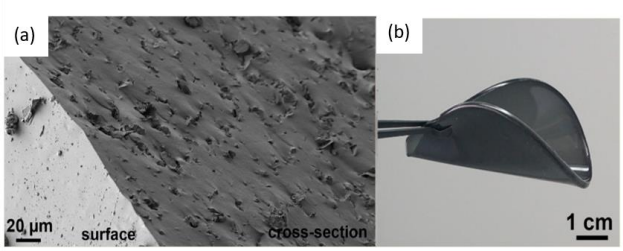

Figure 1: (a) SEM image of graphene/PDMS composite. The cross-section shows random flakes distribution without any visible percolation paths forming. (b) Picture showing the flexibility of fabricated composites.

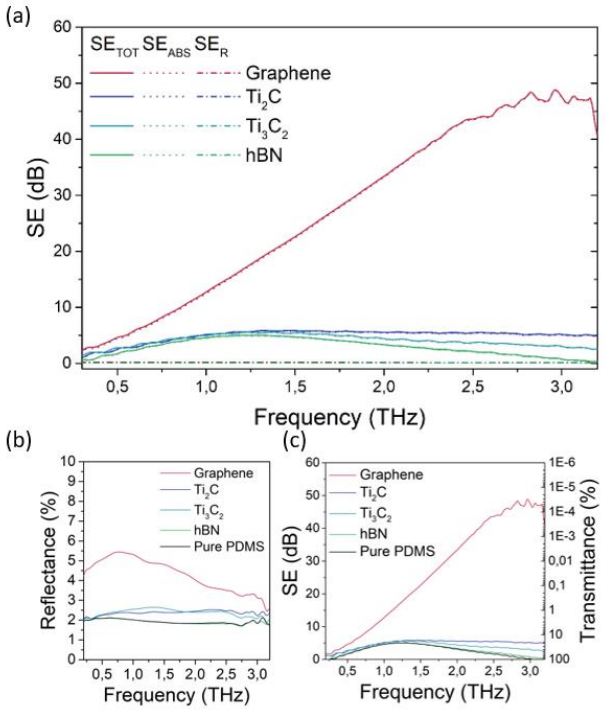

Figure 2: (a) Shielding effectiveness SE_{TOT} and its main components – absorption component SE_{ABS} and reflection component SE_R. (b)(c) Basic optical properties of fabricated composites – (b) reflectance and (c) transmittance as a function of frequency together with calculated SE.