Electromagnetic interference shielding and absorption with 2DM polymer nanocomposites

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Abstract:

With the rapid development of the portable technologies and telecommunication systems such as 5th generation wireless systems, the electromagnetic pollution has become a serious issue. The electromagnetic interference (EMI) issues resulted from electromagnetic induction effects can cause system failure, data misinterpretation/loss and can even lead to harmful health effects. Thanks to their attractive combination of properties, the polymer nanocomposites of emerging 2D materials such as graphene and MXene have shown great promise to efficiently shield/absorb the electromagnetic (EM) waves [1–4].

In our research studies we have developed hybrid polymer composites of 1D materials (e.g. carbon nanotubes (CNT) and SiC-nanowire (SiCnw)) and 2D materials (e.g. graphene and MXene $Ti_3C_2T_x$) for efficient EMI shielding/absorption. For instance, the synergism between the CNTs and graphene resulted in a high shielding effectiveness (SE) of 36.46 dB in the poly(vinylidene fluoride) (PVDF)/CNT/graphene films with the thickness of 0.25 mm [4]. We have also demonstrated that the incorporation of SiCnw into the PVDF/graphene nanocomposites can significantly increase the dielectric loss of the composites by 4 orders of magnitude as compared with the neat PVDF resulting in high EMI SE of 32.5 dB at 1.2 mm thickness [3].

Recently we have developed heterogeneous nanostructures of SiCnw/MXene within a PVDF matrix to develop excellent electromagnetic wave absorption materials. The nanostructured assembly of the 2D MXene nanosheets and 1D SiCnws generated large heterogeneous interfaces in the polymer matrix. This unique structure (Figure 1) led to superior electromagnetic wave absorption properties with an effective bandwidth of 5.0 GHz over the measured frequency range of 12.4−18.0 GHz [1].

Thus, our research works present facile techniques for manufacturing a new class of efficient, flexible, and lightweight electromagnetic wave absorption materials with a tailored nanostructure.

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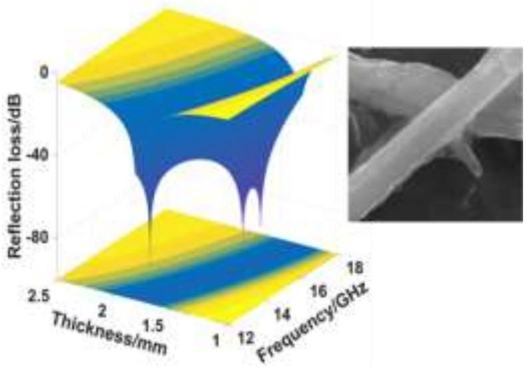

Figure 1: 3D representations of the EM wave absorption performance of polymer/SiCnw/MXene shown in the SEM image.