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Editorial: Dielectric microwave absorbing structures

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Editorial on the Research Topic
Dielectric microwave absorbing structures

After absorbing EM waves the EM-absorbing materials transform the electric energy into heat. Dielectric loss, magnetic loss, and impedance matching are the critical factors which administer the microwave absorption efficiency of a material. In the case of non-magnetic materials, the attenuation mechanism of the microwave absorber mainly proceeds *via* dielectric loss. Conduction loss and relaxation loss which are governed by the conductivity of the materials, and hopping conduction are responsible for the conductivity of the materials. The polarization of the material generates from the presence of functional groups, defects, and the interface between different components of the material. Interface polarization occurs at frequency region (<GHz), whereas another attenuation (originating from atomic, ionic and electron polarization) occurs at high frequency. Conduction losses mainly dominate in metallic, high-conductive materials, whereas dipolar losses dominate in dielectric insulators. In the case of magnetic materials along with conduction losses, magnetic losses (e.g., hysteresis, domain wall resonance, and electron spin resonance) also play important roles.

Though several MW absorbers have been developed, still the problems associated with an undesired adverse effect on the skin, unwanted oxidation, poor thermal stability, and narrow absorption frequency need to be overcome. Hence, the development of an efficient broad range microwave absorbing material is in crucial demand. In this scenario, composite materials, whose components can provide dielectric loss and magnetic loss properties are becoming enticing (Young et al., 2010; Moitra et al., 2017; Zeng et al., 2020; Gogoi et al., 2022; Przybył et al., 2022).

The research papers published on this Research Topic "*Dielectric Microwave Absorbing Structures*" describe the development of microwaving materials, modelling studies, the mechanism involved behind microwave absorption and also a review article on this Research Topic.

Huynen has reported the modelling study of the conductive polymer composite slabs with different architectures of corrugated surfaces for wideband absorption up to 100 GHz. Simulations were performed by employing CST Studio software considering Poly-Lactid-Acid as a dielectric material. Various profiles of corrugation such as square-dot, sinusoidal, or triangular, profiles with varying height, width, and periodicity of the corrugations were investigated to optimize the performances over a large range of frequencies, from 20 GHz to 100 GHz. The targeted reflectivity value was below 10 dB for incidence angles up to 60^0. For the assessment of performances, guidelines have been proposed in terms of specific parameters (Rozanov formalism and figure of merit), which could be helpful to design the optimized configuration of corrugated dielectric slab absorbers. This study provides a new thoroughfare to design compact and efficient broadband microwave absorbers which will be capable to eliminate EM interferences up to 100 GHz.

Wang et al. have reported the synthesis of M-type hexagonal $SrFe_{12}O_{19}$ hexaferrite by employing a molten salt process and investigated its microwave absorption capability in the X band region at different temperatures ranging from 293 to 673 K. In the X band in this temperature range the minimum RL value of the synthesized $SrFe_{12}O_{19}$ was less than −10 dB. This material may show promise to meet the demands of various fields (such as military, national defence, aviation, etc.) where a high-temperature MW absorber at higher temperature (more than 573 K) is highly required.

Naghshara et al. have described the synthesis of nanocomposites composed of activated carbon (derived from Oleaster seed) and ferrite nanoparticles. The optimized Fe_3O_4/activated carbon (AC) demonstrated exquisite EM wave absorption performances by showing −51.12 dB value of maximum reflection loss (RL) and ~ 4 GHz effective absorption bandwidth ((RL < 10 dB) when the thickness is 1 mm. They have explained the boosting of microwave absorbing characteristics of Fe_3O_4/AC composites in the light of different loss mechanisms, improved impedance matching scattering, enhanced specific surface area, etc. This work demonstrates the efficacy of the usage of biomass-derived materials in the fabrication of microwave-absorbing absorbers.

In a review article, Aslibeiki et al. discussed the application of different conductive polymers and their composites as efficient microwave-absorbing materials. In this paper different synthetic strategies and structural properties of different carbon-based materials, other conjugated structures containing heteroatoms in their chains, and the mechanism responsible for their microwave-absorbing properties have been described in detail. This paper elaborates on the designing of tailor-made conjugated polymers which can serve as low-density and high-performance microwave absorbing material.

These articles encompass a comprehensive insight into the aforesaid Research Topic and are providing immense enlightenment to the researchers who are engaging in the development of cutting-edge microwave absorbers.

Author contributions

The author confirms being the sole contributor of this work and has approved it for publication.

Conflict of interest

The author declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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