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A Study on Microwave Absorption Properties of Carbon Black and $Ni_{0.6}Zn_{0.4}Fe_2O_4$ Nanocomposites by Tuning the Matching-Absorbing Layer Structures

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Microwave absorption properties were systematically studied for double-layer carbon black/epoxy resin (CB) and $Ni_{0.6}Zn_{0.4}Fe_2O_4$/epoxy resin (F) nanocomposites in the frequency range of 8 to 18 GHz. The $Ni_{0.6}Zn_{0.4}Fe_2O_4$ nanoparticles were synthesized via high energy ball milling with subsequent sintering while carbon black was commercially purchased. The materials were later incorporated into epoxy resin to fabricate double-layer composite structures with total thicknesses of 2 and 3 mm. The CB1/F1, in which carbon black as matching and ferrite as absorbing layer with each thickness of 1 mm, showed the highest microwave absorption of more than 99.9%, with minimum reflection loss of −33.8 dB but with an absorption bandwidth of only 2.7 GHz. Double layer absorbers with F1/CB1(ferrite as matching and carbon black as absorbing layer with each thickness of 1 mm) structure showed the best microwave absorption performance in which more than 99% microwave energy were absorbed, with promising minimum reflection loss of −24.0 dB, along with a wider bandwidth of 4.8 GHz and yet with a reduced thickness of only 2 mm.

In order to address issues induced by high proliferation of electromagnetic interferences in both civil and military applications, efficient microwave absorbers are becoming highly desirable and necessary. For that reason, such material is required to effectively reduce the reflection of electromagnetic (EM) signals over a broad absorption bandwidth. In order to improve the performance of microwave absorption properties, microwave absorbers are designed to meet the specific requirements of simultaneously having strong absorption, wide frequency band, lightweight and small thickness. Improvements can certainly be made to the designs by physical assembling of different types of absorbents[1–5], chemical decorated absorbents[6,7] as well as by designing multi-layer structures[8–11].

Microwave absorbers are produced using different kinds of materials including one dimensional (1D) materials such as carbon nanotubes[12–15], two dimensional (2D) materials such as graphene[16,17] and bulk three dimensional (3D) materials such as ferrites[9,18–21]. The difference in the dimensional structure of the materials would largely affect the microwave absorption performances since different kinds of structures contribute to different

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