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Hexaferrite Based Flexible Polymeric Nanocomposites for Microwave Absorbing Applications

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Opinion

The flexible microwave absorbers are being considered as new generation materials which have wide applications in the local area network, wireless data communication, radar systems, satellite communication, satellite television, electronic devices and the heating systems, etc. A number of dielectric, magnetic, and magneto – dielectric materials are frequently used as microwave absorbers for various applications. The carbonaceous materials like carbon fiber, carbon nanotubes, graphite and graphene and inorganic materials like metals, metal oxides, and conducting alloys are used to develop the dielectric microwave absorber because of their conducting loss property. The magnetic materials like magnetic metals and their compounds are used to produce magnetic microwave absorber due to their hysteresis loss property. The combined features of the dielectric and magnetic materials together assist in the preparation of magneto – dielectric microwave absorbers. The spinel ferrites are generally employed as magnetic components for the design of microwave absorbing materials. However, the spinel ferrite based microwave absorbers have usually been reported to work at frequencies below 1 GHz. A very high amount of spinel ferrites (~70 - 90 wt %) is required for the design of microwave absorber working above 1 GHz frequency (for example, X-band). However, such high content of spinel ferrites makes the absorbers as heavy in weight due to which their applications in the aerospace industry are constrained. Apart from the heavy weight, the spinel ferrite based microwave absorbers are also restricted in some practical applications due to their large thickness, narrower absorption bandwidths, and the brittleness property. In order to increase the applicability of ferrite based microwave absorbers, the hexagonal ferrites (M-type) appear to be better option due to their relatively high magnetic losses resulting into broadband and efficient microwave absorber for the higher frequency applications (X-band). To circumvent the brittleness of the ferrite/hexagonal ferrite based microwave absorbers and to make them flexible, the hexagonal ferrites can be dispersed into the thermoplast polymers or rubber like host materials.

This ideology of using low density thermoplast polymers as base material also offers the advantage to minimize the heavy weight problem. In the past, a number of the researchers synthesized flexible and wideband microwave absorber for the X-band application using the barium hexaferrite nanopowder as reinforcing element and rubber as host material. For instance, S. Vinayasree et al. reported the hybrid type flexible nanocomposite based on strontium ferrite, carbon black, and nitrile rubber materials to design microwave absorber for S- and X-bands applications [1]. A. Drmota et al. presented polyphenylene sulfide (PPS) polymer and strontium hexaferrite based composite as microwave absorber for 0 – 3.5 GHz microwave frequency range [2]. S. B. Narang et al proposed polyvinyl alcohol (PVA), and Co and Ti doped strontium hexaferrite based soft nanocomposite as microwave absorber for X-band application [3]. S. Chakraborty et al synthesized flexible nanocomposites based on strontium hexaferrite nanopowders embedded in the linear low density polyethylene (LLDPE) matrix to develop microwave absorber for X-band applications [4]. From above discussion, it can be inferred that most of the flexible nanocomposites employ some kind of ferrite nanopowder embedded into either rubber or thermoplast polymers in order to design microwave absorbers for X-band applications. However, use of ferrite powder alone into either rubber or thermoplast polymers would only provide magnetic losses thus providing only one degree of freedom to control the total microwave absorption in the specified frequency band. The aim of this issue is to study the microwave absorbing properties of the hexaferrite based polymeric nanocomposite for their potential use in RADAR, high frequency devices, aerospace and stealth applications.

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