

Design, Processing, and Challenges of Multicomponent Polymer Composites for Improved Electromagnetic Interference Shielding Properties: A Review

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The colossal development of modern electronic devices has inevitably led to an increase in electromagnetic interference (EMI), which has gradually become the fourth most prevalent type of pollution in the world. It is therefore necessary to seek more effective EMI-shielding materials to overcome the shortcomings of conventional metal-based materials, which include high density, a lack of mechanical flexibility, low corrosion resistance and costly processing. Conductive polymer composites (CPCs) have attracted more and more attention due to their superiority in many aspects. However, their performances should be further enhanced for future applications. One polymer with only one type of filler often cannot meet this kind of requirement. In this paper, filled polymer materials for EMI shielding are reviewed in terms of their processing, rheological properties, conductivity, and shielding effectiveness. Moreover, the combination of different ingredients and fillers when fabricating multicomponent composites for EMI shielding is also highlighted. The coordination of various components in composites with different structures, including solid, segregated, layered/sandwiched, and foamed/porous structures, is then discussed.

1. Introduction

1.1. Electromagnetic Radiation (EMR)

Electromagnetic radiation (or waves) is a type of radiation used broadly in the telecommunications field and in a large variety of

electronic devices. This allows the transport of energy without a physical support,^[1] and the use and the properties of each type of electromagnetic radiation are determined by the way that it interacts with matter and by its frequency. The following Figure 1 by Marion^[2] depicts a classification of the different types of EMR or electromagnetic waves based on their frequency and wavelength.

Visible light, radio, TV, and infrared waves, along with X rays, ultraviolet, microwaves, and gamma (γ) rays are all electromagnetic waves. The electromagnetic waves' spectrum can be divided into categories based on frequency. There are low-frequency waves (< 300 Hz), intermediate-frequency waves (between 300 Hz and 10 MHz) and high-frequency waves (> 10 MHz).^[3]

1.2. Risks Related to EMR

With the coming era of 5G and new telecom services to come, more electromagnetic (EM) waves^[4] have resulted from the rapid development of electronic communication and electronic devices, which has caused remarkable problems of EM interference (EMI). For example, EM waves deteriorate the performance of electronic devices, and the

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