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Electromagnetic-wave shielding promulgation of cluster like FZ@MWCNT composite incorporated in GO matrices by polarization relaxation and potential degradation

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ABSTRACT

To protect against the adverse effects of electromagnetic (EM) radiation in the range of radio- to micro-waves, we have developed new polymer-based nanocomposites consisting of high dielectric, magnetic, and conducting columns. We have optimized the synthesis of γ-Fe_2O_3 and ZnO in different potential matrices such as multiwall carbon nanotubes (MWCNT) and graphene oxide (GO), termed as FZ@MWCNT and FZ@MWCNT-GO. Saturation magnetization, coercive field and MT curve suggest the mixture of superparamagnetic and ferrimagnetic nanoparticles blocked at room temperature. The electromagnetic attenuation of these composites containing 60 wt% with paraffin wax shows a significant improvement in the maximum shielding efficiency of 56.7 dB, making FZ@MWCNT and FZ@MWCNT-GO very good candidates for electromagnetic shielding. In addition, the extraordinary enhancement of absorption is attributed to the synergistic effect of dielectric losses due to conductivity, interfacial polarization as well as magnetic losses due to magnetic resonances and eddy current impact.

1. Introduction

Now-a-days the artificial intelligence which is the driving factor behind the next generation of scientific and technological developments is considered as the most strategic high-tech future. The explosive growth of the intelligent era is inextricable from the advancement of various electronic and electrical smart devices, especially with the coming 5G era [1–3]. But the harmful effects of radiations in the range of radio and microwaves emitted from different essential electronic components of communication devices are a burning issue in today's and tomorrow's society. People and electronic devices are not safe for the rapid use of microwave devices in all parts of society [4,5]. Low-dimensional EM functional material with electromagnetic interference (EMI) shielding devices are widely desirable to be protected from the ill effects of microwaves [6]. Due to this rapid expansion of science and technology, the EMI affects the water bodies and also creates air pollution [7,8]. From the human perspective, the adverse effect of EMI is surprisingly profound because it can demolish DNA, weaken the biological immune system, and extensively threaten social health [9]. Besides, microwaves are universally used for detection, navigation, and air communications in the defense system. In current research, there is now a challenge to protect humans, as well as others mentioned above from the ill effect of EMI [10]. Most research in this area is looking for a practical and cost-effective EMI shielding material that can safely protect against all adverse effects in society. To overcome these microwave risks and to protect living and non-living entities, it is necessary to design and fabricate shielding devices. For a good microwave shielding material, it must be physically and chemically stable, have low specific gravity, high absorption, flexibility, a large absorption frequency range, better conductivity, easy implementation, and an economic cost [11]. Since low reflection loss indicates efficient energy conversion and heat production, high electromagnetic absorption allows the material extremely useable on multifunctional electromagnetic nano-micro devices [12]. Conventional applications of metal plates as shielding materials are fundamentally dependent on reflection, not on absorption, which reduces with increasing frequency [10]. The difficulty of application of the metallic system as EMI shielding is limited due to low corrosion resistance, heavy processing, heavy-weight, secondary pollution, high risk of oxidation, and also it needs

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