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journal homepage: <http://www.elsevier.com/locate/jalcom>Graphene@Ni_{0.5}Co_{0.5}Fe₂O₄ hybrid framework with enhanced interfacial polarization for electromagnetic wave absorption

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ABSTRACT

Fabrication of smart materials for electromagnetic (EM) wave absorption has been propounded as efficient EM interference and pollution mitigation method. Herein, a porous lightweight graphene@Ni_{0.5}Co_{0.5}Fe₂O₄ composite was prepared via a coprecipitation method. The results show that Ni_{0.5}Co_{0.5}Fe₂O₄ nanoparticles are homogeneously dispersed and anchored on the graphene flakes. Investigation of the EM waves absorption properties of the material at different filling in paraffin reveals that at 15 wt% loading, the composite absorbs large percent of the EM waves at minimal thickness. The composite attains optimum reflection loss peak −44.7 dB at 17.45 GHz, with 1.5 mm thickness. This enhanced EM wave absorption performance (at lesser thickness than Ni_{0.5}Co_{0.5}Fe₂O₄ in literature) could be ascribed to interfacial polarization and a good impedance match arising from unique pore configuration of the dielectric (graphene) and magnetic (Ni_{0.5}Co_{0.5}Fe₂O₄) composite. These results indicate that the lightweight G@Ni_{0.5}Co_{0.5}Fe₂O₄ composites with strong absorption at reduced thickness is an efficient absorber for high-frequency EM wave attenuation.

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1. Introduction

The demand for smart electronics, wireless communication, and the proliferation of other advanced technologies utilizing electromagnetic (EM) waves are rapidly increasing and progressing. Though these technologies are convenient and abundant, their massive use has resulted in anthropogenic EM noise that affects human health, causing serious diseases like cancer and brain tumors [1]. According to some recent studies, the risk of exposure to EM radiation is high in pregnant women and children. Another consequence of the incessant use of EM applications is EM interference (EMI) that affect the proper functioning of electronic

appliances as a result of radiation from nearby EM power sources [2]. In this case, the effect could be fatal if the harm is caused to a life-supporting device, such as in hospitals. One effective way to suppress EMI is the use of EM wave absorbing material that can dissipate this unwanted EM radiation. Generally, EM wave absorbing materials are of two types, dielectric and magnetic. The use of the traditional EM shielding materials such as aluminum and silver are restricted by their bulkiness, rigidity, high corrosion rate, and difficult processing [3]. Also, they have high conductivity which favors surface reflection of EM waves, which results in secondary EM pollution [2]. Hence, recent advances in EM wave absorption applications have focused on the use of carbon, ceramic, and polymer matrix to achieve a set of desired properties which include strong and broad absorption range at low density and minimal thickness.

Accordingly, carbonaceous materials like carbon nanotubes, graphene, and carbon fiber [4–6] have shown superior properties because of their proper conductivity, vast surface area, and abundance. Among these allotropes, graphene which is composed

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