Chapter 21
Lightweight Nanocomposites Polymers for Shielding Application

Mohamed Darwish
Egyptian Petroleum Research Institute, Egypt

ABSTRACT

Electromagnetic waves can have serious effects on human health by long-term exposure. Developing lightweight materials with good electromagnetic radiation shielding (EMS) that could prevent interference is a high desire for protection. Nanocomposites polymers have a wide range of potential applications and offers suggested solutions in environmental and aerospace applications. This chapter will cover the current challenge in the reduction of electromagnetic wave by developing lightweight absorber material with a wide absorption frequency. A wide range of different nanocomposites polymers contain conductive fillers such as metal or magnetic nanoparticles and carbon-based materials will be discussed. In addition, EMS mechanisms of reflection, absorption, and multiple reflections will be discussed. The unique of the chemical and physical properties of nanocomposites polymers are promising for shielding with low-cost environmentally friendly material.

INTRODUCTION

Electromagnetic pollution appears to be inconvenient with advances in technology and use of electronics and telecommunication devices. Electronic equipment and systems emit waves in the range of microwaves and for this reason the need to shield such radiation arise. Shielding efficacy has paying attention in military applications and in civil communication.

Electromagnetic interference (EMI) can disrupt electronic devices, equipment, and systems that are used in critical applications. Examples include medical, military, and aerospace electronics as shown in (Figure 1). Typical applications are civil and military manned and unmanned aircraft (fixed and rotary wing), spacecraft, missiles, rockets, blimps, and racing vehicles. Electromagnetic shielding is the practice of reducing the electromagnetic field in a space by blocking the field with barriers made of conductive

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or magnetic materials. Shielding is typically applied to enclosures to isolate electrical devices from the 'outside world', and to cables to isolate wires from the environment through which the cable runs. EMI shielding effectiveness is heavily dependent on conductivity- higher conductivity results in better shielding performance. The current challenge in the reduction of electromagnetic wave is to develop lightweight absorber material with a wide absorption frequency (Lagarkov, 2009; Sakai, 2010).

Figure 1. Electromagnetic shielding in aerospace applications
Source: This picture was taken from https://www.conformalcoating.co.uk/index.php/market-sectors/aerospace

The field of astronautics and aerospace presents higher demand for the weight and performance of shielding materials. Shielding materials should meet a series of requirements to suit current demands: and resistant to corrosion and chemicals, lightweight, flexibility and cheap. The fabrication of materials which are capable of shielding incident electromagnetic radiation and meet the criteria mentioned above is nowadays an active field of research.

The presence of nanoparticles in a polymer matrix alters the characteristics of the polymer as the mechanical and thermal properties. Polymer composites offer several advantages over traditional absorber used for electromagnetic interference (EMI) shielding and very promising to be the next-generation shielding materials. Due to the extremely high electrical conductivity, efficient and light weight. (Kasagi, 1999; Li, 1993).

Although polymers are electromagnetic transparent, different strategies are used to shift them into active electromagnetic shields. The incorporation of nanomaterials, such as nanocarbons and magnetic nanoparticles, into matrix of polymer is becoming one of the most effective processes to reach this end. Polymers provide many properties over ceramics and metals in the area of shielding.