

Influence of Graphite Nanosheets on the Structure and Properties of PVC-Based Nanocomposites

Omar A. Al-Hartomy,^{1,2} Falleh Al-Salamy,³ Ahmed A. Al-Ghamdi,² M. Abdel Fatah,⁴ Nikolay Dishovsky,⁵ Farid El-Tantawy⁶

¹Physics Department, Faculty of Science, University of Tabuk, Tabuk 71491, Saudi Arabia

²Physics Department, Faculty of Science, King Abdul Aziz University, Jeddah 21589, Saudi Arabia

³Department of Mathematics, Faculty of Science, University of Tabuk, Tabuk 71491, Saudi Arabia

⁴Department of Chemistry, Faculty of Science, University of Tabuk, Tabuk 71491, Saudi Arabia

⁵Department of Polymer Engineering, University of Chemical Technology and Metallurgy, 8 Kl. Ohridski Blvd., Sofia 1756, Bulgaria

⁶Physics Department, Faculty of Science, Suez Canal University, Ismailia, Egypt

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ABSTRACT: Polyvinyl chloride- (PVC)- based nanocomposites, containing graphite nanosheets (G), which may be used as electromagnetic wave absorbers was developed and investigated. The microstructure of polyvinyl chloride/graphite nanocomposites (PVC/G) were examined by means of X-ray diffraction, scanning electron microscopy (SEM), and thermal gravimetric analyses (TGA). SEM image reveals that the graphite nanosheets were well dispersed in the PVC matrix without agglomeration. Thermal stability of the PVC/G nanocomposites is improved as a result of inclusion of graphite nanosheets. The PVC/G nanocomposites were characterized to investigate the effect of dispersion of graphite nanosheets in PVC matrix. The dielectric spectroscopy of PVC/G nanocomposites in frequency range from 1 to 12 GHz has been performed. The results show that PVC/

G nanocomposites exhibit high dielectric constant at the measured frequencies. Coefficient of attenuation and coefficient of reflection of PVC/G composites have been also examined in a frequency range from 1 to 12 GHz. The electromagnetic interference shielding effectiveness (EMI) depends on graphite volume fraction in the composite. The results show that the PVC/G represents a new class of conducting lightweight nanomaterial that can absorb electromagnetic waves at microwave frequency and may be promising for future commercial use. © 2011 Wiley Periodicals, Inc. *J Appl Polym Sci* 120: 3628–3634, 2011

Key words: graphite nanosheets; nanocomposites; microstructure; dielectric properties; electromagnetic wave shielding

INTRODUCTION

This study is a part of an on-going research project aiming to develop a high-performance nanocomposite material for microwave devices with high attenuation, with good thermal and mechanical properties. The electromagnetic wave transport properties in disordered solids are a topic of considerable interest in condensed matter physics and for engineering purposes, for example, electromagnetic interference shielding (EMI), wave absorption, electronic packaging, vibration damping, and others.^{1–4} With fast development of wireless communications, the electromagnetic radiation is becoming the fourth public pollution after the noise, water, and air pollution.^{5,6} There is an increasing demand to reduce electromagnetic interference such as noise or errors in electronics devices. Such electromag-

netic radiation causes unwanted electromagnetic interference (EMI), which usually damages equipments and harm health of people. It is also needed for avoiding electromagnetic forms of spying. Electromagnetic microwave absorber composites are a critical part of electronic systems in applications such as electromagnetic shielding for air vehicles, wireless communications, and microwave devices.^{4–6} Generally, most of the shielding materials consist of metals. Typical metals and their composites have several disadvantages such as heavy weight, easy corrosion, undurable, and effectiveness only over fixed frequency bands.^{4,5} Hence, the high conducting polymers and their composites have been developed to replace or supplement typical metals for EMI shielding applications, which have merits such as light weight, physical flexibility, and easy control of electrical conductivity.^{5–8} Graphite nanosheets deserve special attention because of their excellent environmental stability, high electrical conductivity, high thermal conductivity, low weight and its great promise in various practical applications to corrosion protection coatings, rechargeable batteries, reinforcements, etc.^{9–13} Conductive filler particles in an

Correspondence to: N. Dishovsky (dishov@uctm.edu).
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