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Sabah Mohammed Al-Mutoki
Al-Furat Al-Awsat Technical University

Ali Abdulabbas
Al-Furat Al-Awsat Technical University

Emad Abbas Jaffar Almulla
Al-Furat Al-Awsat Technical University

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Research Article

Synthesis and Characterization of New Epoxy/titanium Dioxide Nanocomposite

Sabah Mohammed Mlkat al Mutoki[1], Baydaa Abdul-Hassan Khalaf Al-Ghzawi[2], Ali Abdulabbas Abdullah[3], Ammar I.R. AlAmmar[4], Emad A. Jaffar Al-Mulla[5]

[1]Electrical Department, Al Furat Al Awsat University, Technical Institute of Samawa, Samawa, Iraq
[2]Mechanical Department, Al Furat Al Awsat University, Technical Institute of Samawa, Samawa, Iraq
[3]Electrical Department, Al Furat Al Awsat University, Al-Najaf Engineering Technical College, An-Najaf, Iraq
[4]Oil Products Distribution company, Ministry of Oil, Baghdad, Iraq
[5]Department of Chemistry, Faculty of Science, University of Kufa, P.O. Box 21, An-Najaf 54001, Iraq

Corresponding author: E-mail: asabah_sh2003@yahoo.com; imad.almulla@uokufa.edu.iq

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Abstract

Titanium dioxide nano filler (TiO_2) with (10 nm) particle size, and (0.5 wt%) was used as a dopant to epoxy type (SR8100), polymer matrix nanocomposite (PMNC) was prepared by hot vibration dispersion, and tested using FTIR, and UV spectra. It has been found that transmission of (PMNC) largely enhanced, and absorption of UV radiation reaches up to (52%) at (500 nm), (50%) at (1000 nm), and never drop to zero.

Keywords: Nano filler; PMNCs; Hot vibration dispersion

Introduction

Nanocomposites are composites in which at least one of the phases shows dimensions in the nanometre range [1-5]. Conducting polymer-based composites are novel materials with less than a decade of history. It is believed that the total control of the whole conducting polymer-based composite system and the optimization of their physical properties [6]. Nanosized fillers have been introduced in a wide spectrum of applications ranging from providing photo-catalyst activation and conductivity [7, 8] to improving melt processability [9-12] and moisture barrier properties. The special properties of nanoparticles are due to their size and high relative surface area to volume ratio. The optical clarity of a spherical nanosize particle is better than that of its equivalent conventional-size filler, because the diameter is smaller than the wavelengths of light. As a nanosize filler particle has a larger specific surface area than its analogous traditional-size filler particle, it interacts more with its surroundings. Thermodynamic stability of the polymer nanocomposite, which is due to the large interfacial phase between the matrix and the nanoparticle [13, 14], yields the physical properties of the composite. Polymer-based electronics have the capability of being used to make cheap devices [15]. Numerous efforts are being taken to improve the efficiency of the PMNCs electronics. In general a higher density of the nanoparticles is advantageous. Control of the band edge of the particles is also very important factor controlling the efficiency of such items. Polymer semiconductor nanocomposites offer the promise of a new generation of hybrid materials with numerous possibilities of applications such as in optical displays, catalysis, photovoltaics, gas sensors, electrical devices, mechanics, photoconductors and superconductor devices [16-18]. metal and ceramic reinforcements offer striking routes to certain unique magnetic, electronic, optical or catalytic properties coming from inorganic nanoparticles, which add to other polymer properties such as processibility and film forming capability. Using this approach, polymers can be improved while keeping their lightweight and ductile nature [19-21]. Aim of this work was to produce a new PMNC material made from (SR8100) epoxy, and nano (TiO_2) filler, and detect its properties.

Materials and Methods

Epoxy type (SR8100) containing resin and hardener from (SICOMIN, USA), and (99.9%) TiO_2 from (HORIBA, Germany) with particle size distribution as illustrated in Fig. 1 was used as a matrix and filler. Polymer matrix discs were prepared using mould with (2 cm) diameter, and (1 cm) height, resin and hardener was mixed by (1:3 wt%), stirred by a magnetic stirrer for (5 min), then it was purred into the mould leaving for (24 hrs). After solidification we put polymer discs in (2×1 cm) cylindrical mould with a moving base, on the base (0.5 gm) of TiO_2 nano powder was spread, the mould then was heated up to (120 °C) and vibrate at (60 rpm) for (1 hr) to disperse TiO_2 nano particles in epoxy matrix, then it was left to cool down to room temperature. Specimen was tested by UV, and FTIR to detect their properties.

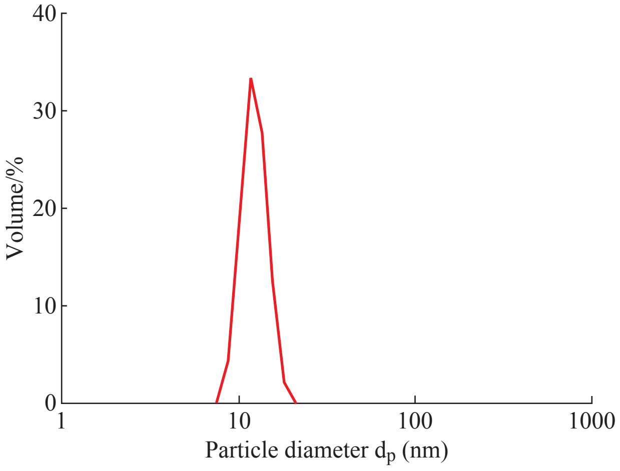

Fig. 1 Particle size distribution of $nTiO_2$.

Results and Discussion

Optical properties to achieve transparency, scattering must be minimized, which means that the nano particles should be as small as possible while the index of refraction should remain as similar as possible to the matrix, excellent use of nano particles in (PMNCs) is in controlling the index of refraction which can be achieved by tailoring the volume fraction of nano particles.

Figures 2-4 illustrate that UV absorption of epoxy type (SR 8100), nano TiO_2, and PMNC of epoxy/nano TiO_2, respectively. It is easily to notice that for both polymer matrix, and nano TiO_2 filler absorption ends at wave length of (500 nm), and gradually approaches to aero at higher wave lengths, while for the PMNC specimen we notice that absorption reach its maximum value at (500 nm) wave length which is (52%), and this is a large enhancement, absorption continue all over wave lengths up to (1100 nm) where it is greater than (50%), while at both polymer matrix, and nano filler it reach to zero at (500 nm), and (400 nm) respectively.

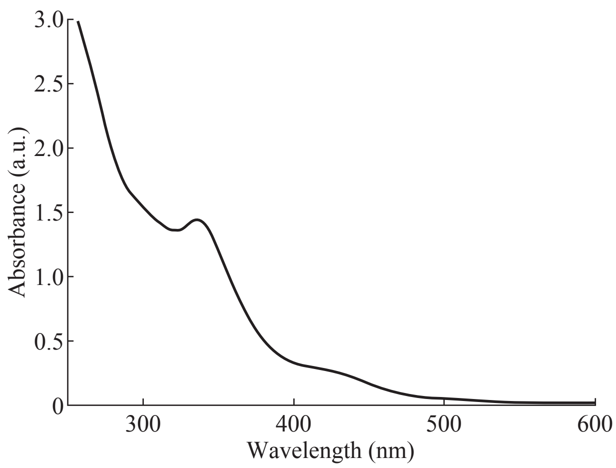

Fig. 2 UV of TiO_2.

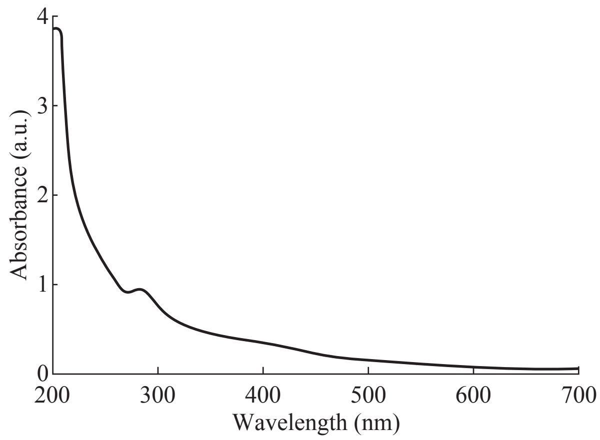

Fig. 3 UV of Epoxy.

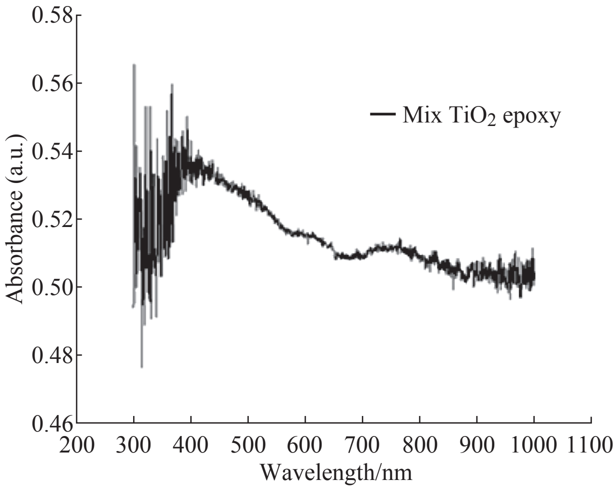

Fig. 4 UV of Epoxy/nano TiO_2 PMNC.

This high absorption rate and its continuity even at higher wave lengths is due to the improvement in PMNC, and this is came from the transition from bulk to surface state.

Figures 5-7 illustrate FTIR of of TiO_2, Epoxy, and Epoxy/nano TiO_2 composite, respectively. We notice that possibility of transmission transfer for the PMNC is too high and contineous, which exactly agree with the results of UV results. PMNC also produce some similar peaks to polymer matrix such as peaks at (1427.32, 1635.64) which refers to phases where epoxy is the dominant, while peaks at (3587.60, 3525.88, 3464.15) are the places where TiO_2 nano filler concentrate.

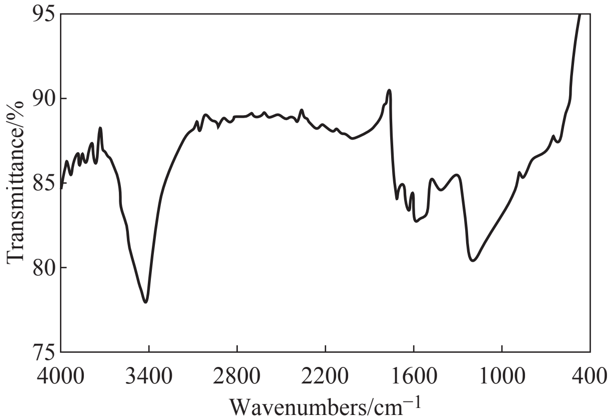

Fig. 5 FTIR of TiO_2.

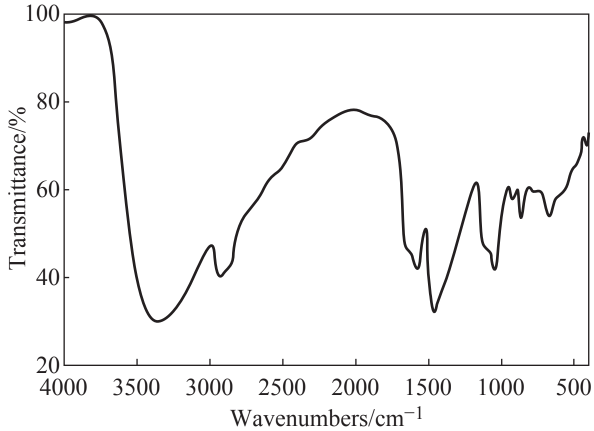

Fig. 6 FTIR of Epoxy.

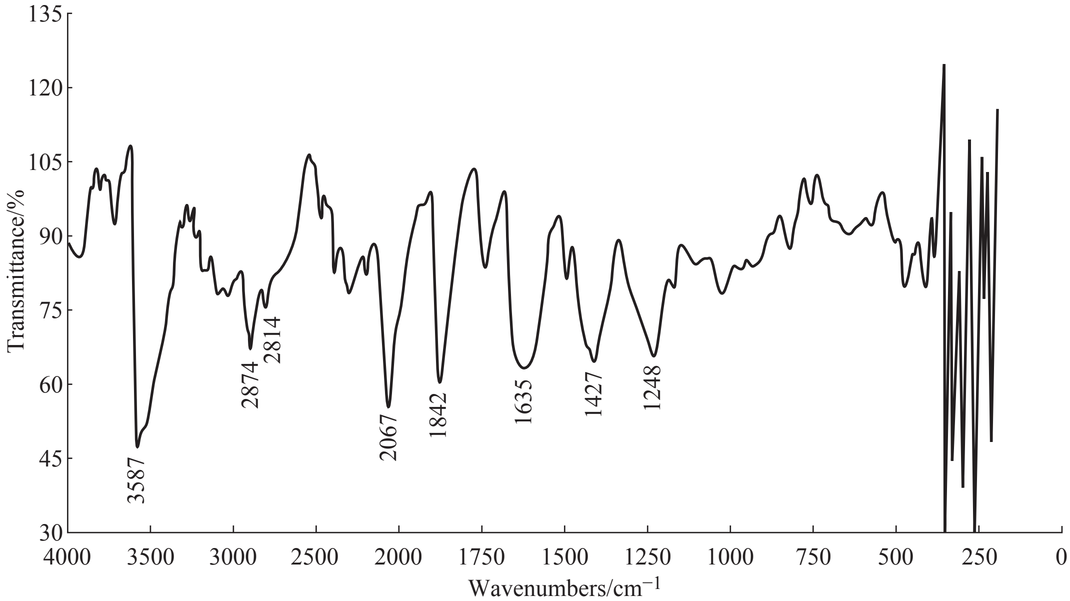

Fig. 7 FTIR of SR8100/nTiO_2 PMNC.

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