UNIVERSITI TEKNOLOGI MARA

STRUCTURAL, THERMAL, AND MECHANICAL PROPERTIES OF PMMA/TiO_2 NANOCOMPOSITES

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Thesis submitted in fulfillment
of the requirements for the degree of
Master of Science

Faculty of Applied Sciences

September 2014

AUTHOR'S DECLARATION

I declare that all the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and it is the results of my work, unless otherwise indicated or acknowledged as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any other degree or qualification.

I, hereby, acknowledge that I have been supplied with the Academic Rules and Regulations for Post graduate, Universiti Teknologi MARA, regulating the conduct of my study and research.

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ABSTRACT

Polymer nanocomposite is a new choice to conventionally filled polymers. Because of the nanometer sizes of filler, filler dispersion in this nanocomposite demonstrates markedly enhanced properties compared to pure polymers include an increased in their modulus and strength, thermal and mechanical properties. In this study, there are two stages involve in preparation the PMMA/TiO_2 nanocomposites. First is the synthesis of TiO_2 nanopowder using sol gel and milling method. The structural properties of TiO_2 synthesized at 0.4 molar precursor concentration with the 6 hour milling time and 4 grams milling amount of TiO_2 in the milling process were measured using Field Emission Scanning Electron Microscopy (FE-SEM), X-Ray Diffraction (XRD), Raman Spectroscopy, Energy Dispersive X-ray Spectroscopy (EDS) and FTIR. TiO_2 produced were confirmed with XRD and Raman Spectroscopy with an anatase structure produced with only anatase phase was observed. Furthermore, EDS results shows that the element of titanium and oxygen detected in the sample and FTIR analysis also shows the bonding of Ti-O-Ti was observed from the sample. In the second stage, an optimized TiO_2 nanopowder were mixed with PMMA to produce PMMA/TiO_2 nanocomposites. This polymer nanocomposites was prepared by mixing TiO_2 nanofiller into polymer PMMA matrix using sonication and solution casting technique. The structural, thermal and mechanical properties of PMMA/TiO_2 nanocomposites were investigated. The structural properties of PMMA/TiO_2 nanocomposites showing an increase of TiO_2 amount in PMMA produce an increase many cracks on the sample surface observed by FESEM. Meanwhile, for the thermal properties, *Tg* increase when TiO_2 filler is added into PMMA. The thermal degradation of the nanocomposite also increases when amount of TiO_2 increased. Further, mechanical properties of nanocomposite also show the modulus increased with TiO_2 amount, up to 15 wt% TiO_2 in PMMA. The 15 wt% TiO_2 nanopowder in PMMA is the optimized one due to high modulus obtained. When the amount of TiO_2 nanopowder is higher than 15 wt%, modulus of the sample drop drastically due to the brittle properties of the nanocomposited samples observed. Higher amounts of TiO_2 in PMMA increase an intercalation of TiO_2 between the polymer chains, thus, weaken the polymer. Effect of TiO_2 nanoparticle filler size also was investigated. Smaller size of the filler shows higher thermal and mechanical properties of the nanocomposite. Good thermal and mechanical properties of PMMA/TiO_2 nanocomposites contribute to the various applications for this nanocomposite applications such as in household applications, electronic, aerospace and also in biotechnology applications.

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