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Influence of ZrO2 nanoparticles and thermal treatment on the properties of PMMA/ZrO2 hybrid coatings (Article)

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Abstract

In this work, ZrO2 nanoparticles were synthesized by the sol-gel method, treated thermally at different temperatures (400, 600 and 800 °C), and added to a polymer matrix in two different weight percentages (0.5 and 1) by single screw extrusion in order to determine the influence of these parameters on the thermal stability and UV radiation resistance of PMMA/ZrO2 composites. Fourier transform infrared spectroscopy (FT-IR), nuclear magnetic resonance (NMR), X-ray diffraction (XRD), transmission electron microscopy (TEM), confocal laser scanning microscopy (CLSM), ultraviolet-visible spectroscopy (UV-Vis), thermogravimetric analysis (TGA) and nanoindentation techniques were used to evaluate the structural, morphological, optical, thermal and mechanical properties of as-prepared composites. The average crystallite sizes for ZrO2 sintered at 600 and 800 °C were about 17 and 26 nm, respectively. It was found that the incorporation of a low percentage of ZrO2 nanoparticles increased the thermal properties of PMMA as well as its hardness and elastic modulus. The degradation temperature at 10 wt.% loss of the PMMA/ZrO2 (0.5 wt.%, 400 °C) nanocomposite was approximately 48 °C higher than that of pure PMMA. The absorption in the UV region was increased according to the ZrO2 heat treatment temperature and amount added to the polymer matrix.

Author keywords

Nanoparticles; PMMA; Polymer nanocomposites; UV radiation resistance; ZrO2