EFFECT OF PARTICLE MORPHOLOGY ON THE PROPERTIES OF POLYPROPYLENE/NANOMETRIC ZINC OXIDE (PP/NANOZNO) COMPOSITES

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Received 16 April 2009; accepted 9 July 2009

ABSTRACT

Polypropylene/nanometric zinc oxide (PP/nanoZnO) composites at 1 wt% nanoZnO content were prepared using melt blending method using a thermo Haake internal mixer. Three different types of zinc oxide (ZnO) with different morphologies were used as fillers. Each composite was subjected to characterization analyses including tensile testing, UV-vis spectroscopy and electron microscopy. The tensile strength, tensile modulus and elongation at break of the PP/nanoZnO composites were observed to be greatly enhanced despite the low filler content (1 wt%). All ZnO-reinforced composites exhibited superior UV absorption characteristic especially for composite specimens reinforced with ZnO morphology rich in nanorods.

Keywords: Polymer matrix composites; Nano zinc oxide; Mechanical properties

1. INTRODUCTION

Semicrystalline polypropylene (PP), a useful and versatile commodity thermoplastic, could be the most popular matrix for nanocomposites study. To date, PP is widely used in packaging, automotive and aerospace industries. Among the main reasons for the popularity of PP are its structural flexibility, high isotacticity, good mechanical performance, narrow molecular weight distribution and good optical transluence [1-3]. In recent years, the incorporation of nanoparticles in PP matrix has generated intense enthusiasm among polymer scientists due to its promising industrial applications in many facets of technology. Nanocomposites with good filler dispersion offer significant improvements in mechanical, thermal, electrical, optical and physico-chemical properties even at relatively low filler content [4-6].

Zinc oxide (ZnO) is an important optoelectronic material characterize by a wide direct band-gape of 3.37 eV (room temperature) and large excitation binding energy of 60 meV. ZnO is currently applied in healthcare, rubber, varistors, paint, ceramics and cosmetics [7-12]. Feng et al. reported that the incorporation of 10 - 12 wt% of nanoZnO into PP matrix can increase the composite surface resistance and electrostatic voltage to very low values of 10^9 Ω and 250 V, respectively. Significant improvement in wear resistance, tensile strength, impact strength and crystallization were also reported for PP/nanoZnO composites [9, 13-14]. Interestingly, PP/nanoZnO composites possess excellent antibacterial capability against two human pathogenic bacteria such as Staphylococcus aureus and Klebsiella pneumoniae, making it a suitable candidate for food packaging applications [7]. Ammala et al. investigated the degradation behaviour of nanoZnO/PP under UV radiation by comparing the conventional hindered amine light stabilizers (HALS) with ZnO, and they reported excellent resistance to UV degradation for specimens embedded with 2 wt% of nanoZnO [15].

ZnO can be fabricated into various morphologies resembling rods, wires, plates, mallets, drums, belts, mallets, tubes, cages and flowers [11-12]. With re-