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Surface-activated nanosilica treated with silane coupling agents/polypropylene composites: Mechanical, morphological, and thermal studies

Abstract

This work reports the mechanical, morphological, and thermal properties of the polypropylene (PP) nanocomposites containing nanosilica (nano-SiO 2) which were treated by different functional group silane coupling agents. Four types of silane coupling agents namely aminopropyltriethoxy silane (APTES), glycidyloxypropyltrimethoxy silane (GPTMS), trimethoxysilylpropyl methacrylate (TMPM), and dichlorodimethyl silane (DCMS) were used to modify the surface-activated nanosilica. To enhance the effectiveness of the coupling, nanosilica was chemically activated and analyzed through FTIR and X-ray photo electron spectroscopy (XPS). The highest tensile strength was recorded by the activated nanocomposites treated with APTES followed by nanocomposite treated with GPTMS, TMPM, and DCMS, respectively. The addition of silane coupling agents into nano-SiO2/PP system further improved the tensile modulus of the PP nanocomposites. From the transmission electron microscopy (TEM) analysis, activated nanosilica treated with APTES showed better nanosilica dispersion in the PP matrix and lesser agglomeration occurred when compared with the other silane coupling agents which were used in this study. Surface activation process does not effectively increase the degree of crystallinity and thermal stability on the PP nanocomposites. However, with the assistance of the surface treatment, it was found that the thermal behavior of the PP nanocomposites had been enhanced.

Keywords — Silane coupling agent, surface activation, thermal behaviors, thermal study, Coupling agents, polypropylenes