Thermal Decomposition Kinetics of Poly(ethylene 2,6-naphthalate) Nanocomposite Reinforced with ZnO Nanoparticles

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The processing of polymer nanocomposites reinforced with various nanofillers is believed to become a key technology on advanced materials for next generation, in that the unique characteristics of nanoparticles made it possible for them to be used as promising nanofillers in polymer nanocomposites [1–3]. In this regard, much research has been performed on the practical realization of excellent properties of nanoparticles for advanced composite in a broad range of industrial applications. However, because of their high cost and limited availability, only a few practical applications in industrial fields have been realized to date. Considering these aspects, it is very instructive to fabricate polymer nanocomposites based on conventional cheap thermoplastic polymers and very small quantity of nanoparticles at lower manufacturing cost, from an industrial perspective. poly(ethylene 2,6-naphthalate) (PEN) thus holds a potential for industrial applications, including food packaging materials, magnetic recording tapes, flexible printed circuits, and high-performance industrial fibers.

In this study, polymer nanocomposite based on PEN and ZnO nanoparticles was prepared by direct melt compounding to create high-performance composite materials with low cost for possible practical applications in various industrial fields, and the resultant nanocomposites were characterized by means of differential scanning calorimetry (DSC), thermogravimetry analysis (TGA), and scanning electron microscopy (SEM) to clarify the effects of ZnO nanoparticles on the thermal stability, the thermal decomposition behavior, and the dynamic mechanical properties of the PEN/ZnO nanocomposites. This study will help in understanding the thermal stability and thermal decomposition behavior of the PEN/ZnO nanocomposites.

The PEN/ZnO nanocomposites containing a very small quantity of ZnO nanoparticles exhibited better physical properties than that of pure PEN. There was strong dependence of the thermal decomposition kinetics of PEN/ZnO nanocomposites on the ZnO content and the heating rate. The variations of the activation energy for thermal decomposition of PEN/ZnO nanocomposites reflected that the introduction of a very small quantity of ZnO nanoparticles into the PEN matrix enhanced the thermal stability of PEN/ZnO nanocomposites. The incorporated ZnO nanoparticles play a crucial role in improving the thermal stability by acting as effective physical barriers against the thermal decomposition in the polymer nanocomposites. This study suggests that the ZnO nanoparticles are beneficial to act as thermal decomposition resistant and reinforcing nanofillers in the PEN matrix.

REFERENCES