THE INFLUENCE OF TiO_2 NANOPARTICLES ON THERMAL DECOMPOSITION OF POLYURETHANE SOFT SEGMENTS

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Abstract

Testing the behavior of polymeric materials during heating, especially when it comes to materials that have wide practical application and therefore large commercial importance, such as polyurethanes, is essential. Results obtained by investigating thermal stability and thermal decomposition of polymers, including kinetic modeling, can help to understand the mechanism of thermal degradation reaction and also can be very helpful in an attempt to predict and roughly evaluate lifetime of polymeric materials. In relation to that, the aim of this work was to examine the effect of unmodified and surface modified TiO_2 nanoparticles on thermal degradation and thermal degradation kinetics of the soft segments of polyurethane network based on polycaprolactone and aliphatic hyperbranched polyester. Surface modification of TiO_2 nanoparticles was performed using gallic acid ester having C12 long alkyl chain (lauryl gallate). Results obtained by thermogravimetric analysis performed at different heating rates in nitrogen atmosphere for pure polyurethane and composites prepared by incorporation of 1.0 wt.% of unmodified or surface modified TiO_2 nanoparticles into polyurethane matrix were compared. It was established that thermal decomposition of soft segments, i.e. polycaprolactone, is shifted to higher temperatures for composites, and this shift is more pronounced for the sample prepared with modified TiO_2 nanoparticles. Furthermore, using values of the activation energy of thermal degradation calculated by model-free Ozawa-Flyyn-Wall method, together with Coats-Redfern model-fitting method and numerous kinetic models, the degradation mechanism of soft segments was investigated. It has been shown that the best fitting kinetic model which can be applied to describe thermal degradation mechanism of the soft polycaprolactone segments in the prepared samples is the second (for pure polyurethane), i.e. the third (for composites) reaction order kinetic model.

Keywords: *polyurethane, TiO_2 nanoparticles, composites, thermal degradation, kinetics.*

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