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Thermal Analysis and Characterization of Polystyrene Initiated by Benzoyl Peroxide

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Abstract

Based on the complexity of the polystyrene polymerization mechanism initiated by benzoyl peroxide (BPO), the thermal risk of the reaction process was estimated using thermal analysis and characterization. The polymerization process was thermally analysed using an adiabatic rate calorimeter and differential scanning calorimeter. The results demonstrated that the onset reaction temperature, adiabatic temperature rise, and maximum temperature of the synthesis reaction of BPO-initiated polymerization were lower than those of thermos initiated polymerization. Moreover, nuclear magnetic resonance imaging, gel permeation chromatography, and Fourier transform infrared spectrometry were used to characterize the polymerization products obtained under the two initiation conditions. The polystyrene obtained using the two initiation methods had the same hydrogen structure; however, their molecular weight and distribution uniformity differed considerably, and the BPO-initiated process was discovered to include the effects of the thermos initiated process. Moreover, the free radicals produced by BPO decomposition participated in the chain reaction of polystyrene polymerization, accelerated instantaneous grain growth, and promoted the formation of short-chain polystyrene. In summary, the BPO-initiated polymerization process exhibited the desired thermal safety characteristics and has potential for practical use.

Keywords: Polymerization mechanism, Thermal risk, Polymerization products, BPO-initiated, Thermo initiated, Characterization, Polystyrene.