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Synthesis and polymerization kinetics of rigid tricyanate ester

Galukhin A., Nosov R., Nikolaev I., Melnikova E., Islamov D., Vyazovkin S.
Kazan Federal University, 420008, Kremlevskaya 18, Kazan, Russia

Abstract

A new rigid tricyanate ester consisting of seven conjugated aromatic units is synthesized, and its structure is confirmed by X-ray analysis. This ester undergoes thermally stimulated polymerization in a liquid state. Conventional and temperature-modulated differential scanning calorimetry techniques are employed to study the polymerization kinetics. A transition of polymerization from a kinetic- to a diffusion-controlled regime is detected. Kinetic analysis is performed by combining isoconversional and model-based computations. It demonstrates that polymerization in the kinetically controlled regime of the present monomer can be described as a quasi-single-step, auto-catalytic, process. The diffusion contribution is parameterized by the Fournier model. Kinetic analysis is complemented by characterization of thermal properties of the corresponding polymerization product by means of thermogravimetric and thermomechanical analyses. Overall, the obtained experimental results are consistent with our hypothesis about the relation between the rigidity and functionality of the cyanate ester monomer, on the one hand, and its reactivity and glass transition temperature of the corresponding polymer, on the other hand.

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Keywords

Cyanate esters, Diffusion control, Isoconversional kinetic analysis, Polymerization kinetics, Thermal analysis, Vitrification

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