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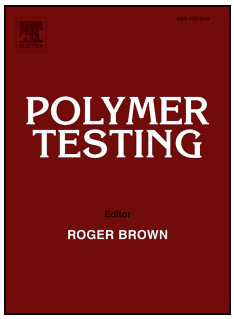

Isothermal curing of the glycidyl azide polymer binder system by microcalorimetry

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Isothermal Curing of the Glycidyl Azide Polymer Binder System by Microcalorimetry

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Abstract: Microcalorimetry was used to monitor the heat flow of the curing reaction between glycidyl azido polymer (GAP) and various isocyanate curatives. The curing kinetics was investigated in the temperature range 308.15-323.15 K, and the activation energy, activation free energy, activation enthalpy, and activation entropy of the curing reaction between GAP and polyaryl polymethylene isocyanate (PAPI) were obtained. The thermodynamic properties of the reaction were also studied by varying the amount of PAPI at 323.15 K. The rate constant slightly increased with the increasing content of PAPI. Moreover, a model function of $da/dt = 10^{-4.30}(1-a)^{1.62}$ was applied to describe the curing reaction of the GAP-PAPI binder system at 323.15 K.

Keywords: GAP-PAPI; microcalorimetry; curing kinetics; thermodynamic properties

1. Introduction

In general, the efficiency and performance of plastic-bonded explosives (PBXs) and propellants depend on the surface area, physical feature, and mechanical properties of binders [1, 2]. As an energetic hydroxy-terminated azido polymer, glycidyl azido polymer (GAP) has been extensively studied to replace conventional inert binders, such as hydroxy-terminated polybutadiene (HTPB) and hydroxy-terminated polyether (HTPE), in the urethane reaction for PBX and solid composite propellants [3-6]. Hydroxyl functional groups of GAP undergo stoichiometric urethane reactions with a variety of isocyanates to form the polyurethane (PU) network, resulting in a product with excellent mechanical properties [7, 8]. Thus, understanding the cure rate and kinetics became

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