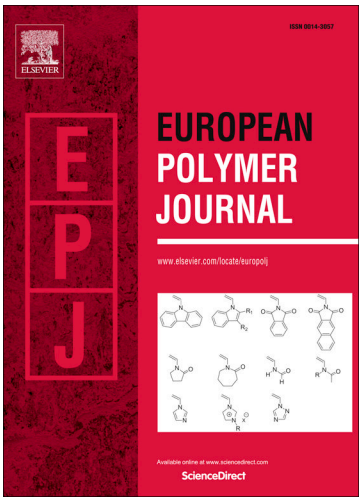

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Allyl Phenolic-Phthalonitrile Resins with Tunable Properties: Curing, Processability and Thermal Stability

Shuangshuang Xu,[a] Yue Han,[b] Ying Guo,[b] Zhenhua Luo,[b] Li Ye,[b] Zheng Li,[b] Heng Zhou,[b,*] Yan Zhao,[a,*] Tong Zhao[b]

[a] School of Material Science and Engineering, Beihang University, Beijing 100191, China

[b] Laboratory of Advanced Polymer Material, Institute of Chemistry, Chinese Academy of Sciences, Beijing 100190, China

Abstract

In order to modify the curing procedure and broaden the processing windows of phthalonitrile, allyl phenolic moieties were incorporated into phthalonitrile resins at different ratios through sequential nucleophilic substitution reaction. The curing behavior, along with the reaction between allyl and nitrile groups, were investigated in detail. The curing kinetic equations were derived by Šesták-Berggren (SB) model. The rheological tests showed that the minimum viscosity significantly decreased from 15 Pa•s to less than 1 Pa•s and the processing windows varied from 24 °C to 89 °C with the allylation degree increasing. The novel oligomers demonstrated a maximum $T_{5\%}$ of 494 °C, 74% char yield at 1000 °C and a high glass transition temperature exceeding 400 °C. The correlation between allylation degree and concerned parameters, including curing temperatures, processing windows and $T_{5\%}$ was established, which allows for tailoring polymer structure for various applications.

Keywords: phthalonitrile, allyl, processing, thermal properties, curing kinetics

1. Introduction

Thermosetting resins exhibiting high heat resistance are widely used in aeronautics and electronics fields [1]. They all share the common advantages such as excellent thermal and thermo-oxidative stabilities and outstanding mechanical properties at elevated temperatures [2, 3]. However, broadening processing windows while maintaining necessary thermal and mechanical performance has been always a dilemma for the development of high temperature resins [4, 5].

* Corresponding author.
E-mail: zhouheng@iccas.ac.cn (H. Zhou) or jennyzhaoyan@buaa.edu.cn (Y. Zhao).