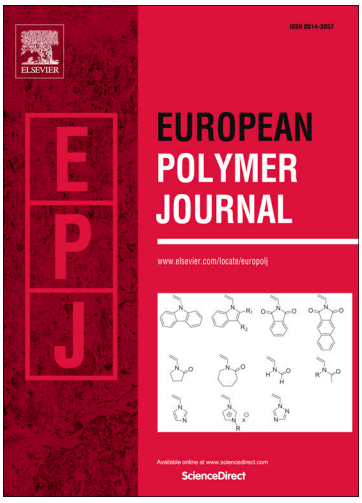

Synthesis and characterization of benzocyclobutene- terminated imides with high organosolubility

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Synthesis and characterization of benzocyclobutene-terminated imides with high organosolubility

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Abstract

Benzocyclobutene resins play an important role in microelectronic industry owing to their excellent physical and chemical properties. In our work, three novel benzocyclobutene-terminated imide monomers were synthesized via the reaction of 1-aminomethyl benzocyclobutene with various aromatic dianhydrides. The monomers exhibited good processability with superior solubility and low melting points (< 163.5 °C), and they showed similar curing behaviors under N_2 with an exothermic peak in differential scanning calorimetry (DSC) curves ranging from 217.3 °C to 287.7 °C. Highly crosslinked resins obtained at 150-300 °C exhibited superior tensile strength (> 74.3 MPa), outstanding thermal stability (T_d > 466 °C in N_2), high glass transition temperature (> 278 °C), high storage modulus (> 3.25 GPa at 30 °C), low dielectric constant (< 3.07 at 1 MHz) and good water resistance (the water absorption was below 0.81 % after immersed in water for 24 h and the water contact angle was higher than 86.6°). Atomic force microscopy demonstrated the perfect uniformity and planarity of the cured films.

Keywords: Benzocyclobutene; Imide; Thermosets

1. Introduction

Benzocyclobutene (BCB) thermosetting resins have been widely concerned and developed rapidly in microelectronics industry in recent years owing to their excellent properties such as good mechanical properties, high heat resistance, strong adhesion, high electric insulation and low dielectric constant [1-6]. BCB undergoes ring-opening isomerization reaction at high temperature to generate a highly active o-dimethoquinone intermediate, which immediately react with itself and produce dimer or polymer through a spiro intermediate [6,7]. It can also have Diels-Alder reaction with dienophiles to generate six-membered ring structures [8]. BCB monomers can turn into thermosetting resins by heating without any catalyst or additive, and no by-product is released during the curing process, leading to the low shrinkage, good film-forming property and perfect planarity of BCB resins.

BCB group has been introduced to linear polymers to serve as a thermally cross-linkable group in many studies [9-11,44]. The incorporation of BCB group