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Preparation of Cationic Latent Initiators Containing Imidazole Group and Their Effects on the Properties of DGEBA Epoxy Resin

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Abstract: The thermal cationic latent initiators, *N*-benzyl-3-methylimidazolium hexafluoroantimonate (BMH1) and *N*-butyl-3-methylimidazolium hexafluoroantimonate (BMH2) were synthesized and applied to the thermal cationic polymerization of diglycidyl ether of bisphenol A (DGEBA). The performance of BMH1 and BMH2 was examined by differential scanning calorimetry (DSC), which showed good thermal latent properties and excelled epoxy resin curing behavior. The morphology, thermal, mechanical, and water sorption properties of DGEBA resin cured by 1 wt% of BMH1 and BMH2 were measured by X-ray diffraction (XRD), scaming electron microscopy (SEM), thermogravimetric analysis (TGA), nanoindentation, and thin film diffusion analysis. The cured DGEBA/BMH1 system showed relatively higher thermal stability than the DGEBA/BMH2 system. The diffusion coefficient and water uptake were 14.2×10^{-9} cm^2/s and 1.15 wt% for the DGEBA/BMH1 system and 11.5×10^{-9} cm^2/s and 1.07 wt% for the DGEBA/BMH2 system, respectively. Therefore, DGEBA/BMH2 showed higher resistance to water sorption than DGEBA/BMH1. On the other hand, hardness and elastic modulus of DGEBA/BMH2 were higher than those of DGEBA/BMH1. This can be attributed to the difference in the end group of initiators as well as the degree of crosslinking in the cured resin network.

Keywords: cationic polymerization, epoxy resin, thermal latent catalysts, thermal properties, mechanical properties and water sorption.

Introduction

Epoxy resins have shown excellent properties such as insulating characteristics, good adhesion strength, chemical resistance, *etc*., and are widely used in various fields including paints and coatings. It have been used as adhesives for cosmetic and food packaging materials, industrial composite materials, electrical system and electronics, and aerospace applications.[1] In particular, diglycidyl ether of bisphenol A (DGEBA) is frequently studied and commercially used because of its superior heat resistance, dimensional stability, and good mechanical properties among thermosetting resins. It is well known that the properties of epoxy resins are strongly dependent upon the chemical structure of curing agent.[2,3] For the curing of epoxy resins, adding of curing agent is indispensable. A curing agent is needed to initiate the ring-opening polymerization of epoxy to convert it into three-dimensional network and the final properties of the epoxy resins are determined by crosslinked structures. Therefore, the application ranges of the epoxy product depend largely on the selection of the curing agent.[4,5] Amines and anhydrides have commonly been used as curing agents although they are very toxic in use and require high energy consumption due to a long curing time at a high temperature.[6,7]

Recently, glowing concerns for energy savings and eco-friendly processes promote the development of cationic latent initiators as curing agents of epoxy resins.[8] This is because the cationic latent initiators can be used to control the initiation and curing process of an epoxy system effectively and increase the efficiency of curing process.[9] In addition, cationic latent initiators have many advantages in handling and storage of epoxy resins because the curing of epoxy is initiated only when it is stimulated by a certain

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