IL-03

Preparation and Curing of High Molecular Weight Polybenzoxazine Precursors and the Properties of the Thermosets

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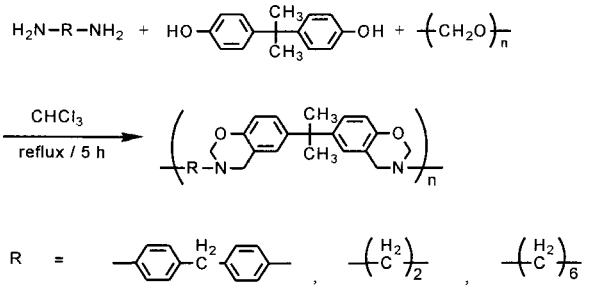
Polybenzoxazines are now interesting as novel type of phenolic resin that can be prepared by the ring opening polymerization of cyclic monomers, benzoxazines. Polybenzoxazines have the characteristics found in the traditional phenolic resin such as excellent thermal properties. They also have many characteristics that are not found in the traditional phenolic resin such as the molecular design flexibility, excellent dimensional stability, and no evolution of volatiles during the cure process. Various approaches have been done aiming for further performance improvement of polybenzoxazines[1,2]. So far, only low molecular weight cyclic monomers have been used as precursors for polybenzoxazines.

In this study, we are presenting a new approach to prepare high molecular weight polybenzoxazine precursors from aromatic or aliphatic diamines and bisphenol-A with paraformaldehyde. The precursors were obtained as soluble white powder. The structure of the precursors was confirmed by IR, ^{1}H-NMR and elemental analysis. The ratio of the ring-closed benzoxazine structure and the ring-opened structure in the high molecular weight precursor was estimated from ^{1}H-NMR spectrum and also from the exotherm of DSC.



Scheme 1. Preparation of Polybenzoxazine Precursors

The precursor solution was cast on glass plate, giving transparent and self-standing precursor films, which was thermally cured up to 240°C to give brown transparent polybenzoxazine films. The toughness of the crosslinked polybenzoxazine films from the high molecular weight precursors was greatly enhanced compared with the cured film from the typical low molecular weight monomer. The viscoelastic analyses showed that the glass transition temperature of the polybenzoxazines derived from the high molecular weight precursors were as high as 238~260 °C. Additionally, these novel polybenzoxazine thermosets showed excellent thermal stability.

1. Agag, T.; Takeichi, T. *Macromolecules*, **36**, 6060 (2003)
2. Takeichi, T.; Guo, Y.; Rimdusit, S. *Polymer*, **46**, 4909 (2005)