Transfer Moldable, Low Viscosity Benzoxazine Resins that Polymerize with Multiple Mechanisms into High Performance Polymers with Tg above 250°C.

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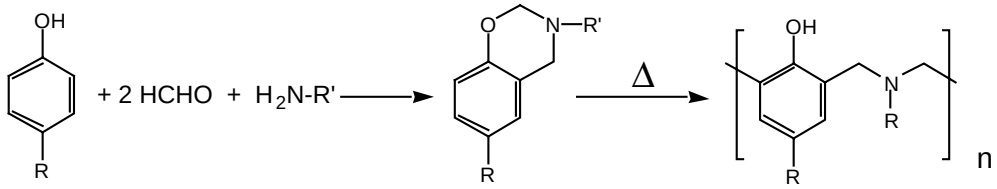
Abstract

The benzoxazine resins can be easily synthesized from a phenolic derivative, formaldehyde and a primary amine derivative. The benzoxazines are a class of resins that polymerize via a cationic ring opening mechanism, resulting in phenolic polymers.



The polybenzoxazines show excellent mechanical, physical and chemical properties in comparison to existing commercial resins. They polymerize with nearly zero shrinkage with no volatiles produced; develop mechanical and physical properties at an early stage of conversion; show very high char yield, low water up-take and low dielectric constant; are self-extinguishing; and possess extremely rich molecular design flexibility. In the past, we have concentrated on the difunctional benzoxazines for achieving high thermal properties via cross-linked structures, as typical mono-functional benzoxazines lead to oligomers. However, combining mono-functional benzoxazines with chemical functionalities that polymerize via other polymerization mechanisms offer advantages, including low viscosity, and controlled polymerization with multiple conditions and catalysts. In this lecture, we will introduce the benzoxazine resins with R and R' groups that are polymerizable with different mechanisms. When maleimide is adopted for the R group, the polybenzoxazine resin exhibit excellent mechanical and physical properties, such as Tg around 270°C, low viscosity, while preserving all the other advantageous properties of polybenzoxazines. A carbon fiber cloth (Thornel T-300) reinforced polybenzoxazine exhibited flexural strength as high as above 1 GPa, which compares with the comparable impact-modified epoxy of approximately 700 MPa and impact modified phenolic resin of 600 MPa. Benzoxazine resins are transfer moldable. An example of transfer molded polybenzoxazine will be discussed. The newly developed benzoxazine resins are ideally suited for transfer molding, high performance composites.