Advances In High-Temperature Thermosetting Polyimides

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ABSTRACT

The recent surge in the development of high-temperature thermosetting polyimides has been driven by an increasing demand for high speed aircrafts, affordable access to space and non-aerospace cutting edge technologies for international competitive advantages. The reactive end-capping groups play a key role in determining the chemistry, properties and applications of thermosetting polyimides. Therefore, it is natural to classify them into three major types. These are nadic end-capped PMR (Polymerization of Monomer Reactants) polyimides, ethynyl-terminated polyimides, which are further sub-divided into acetylence- and aryl ethynyl-terminated polyimides, and maleimid-terminated polyimides. Bismaleimides are popular for use in the temperature range of 150 – 250°C because of their epoxy-like easy processing and polyimide-like thermal performance. PMR polyimides are suitable for higher use temperatures up to 371°C because of their outstanding thermo-oxidative stability. Acetylence-terminated Thermid materials are less favored because of their difficulty in processing, although improvements in their processability are emerging. The more recently developed aryl ethynyl-terminated polyimides offer a very attractive combination of good toughness and high temperature performance up to 300°C. However, their high cost remains an obstacle to wide spread acceptance, particularly by non-aerospace industries. A resin transfer molding phenylethynyl-terminated polyimide resin system is been developed to lower the cost of fabrication. The chemistry, properties, and applications of these three major types of thermosetting polyimides are presented.