Curing of Phenylethynyl Terminated Resins.

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The curing of two phenylethynyl terminated composite resins was investigated under thermal and γ-irradiation conditions. The resins, PETI5A and DFB/BPF have been specially developed by NASA[1,2] for high temperature aerospace applications, and as such have been synthesised[1,2] with a high degree of aromaticity and hence lack of aliphatic protons.

The thermal curing occurs via the thermal decomposition of the resin to form radicals which initiate the addition polymerisation which proceeds through the ethynyl units. The decomposition processes at the cure temperature of 360°C lead to the formation of a very dark coloured resin. The radiation cured resin was significantly lighter in colour, indicating less degradation of the resin.

In order to reduce the degree of thermal decomposition during polymerisation, γ-radiation induced cure was attempted at 300°C.

The loss of ethynyl bonds was monitored for both the thermal and radiation induced curing with FT-Raman Spectroscopy and the formation of a polymer network was observed using Differential Scanning Calorimetry (DSC).

The maximum Glass Transition Temperatures (T_g) for the resins was found to be 245 ± 2°C for DFB/BPF in 60 minutes and 360 ± 2°C for PETI5A in 100 minutes for thermal cure at 360°C. Similar values were observed after γ-irradiation to doses of approximately 40 kGy for DFB/BPF and 80 kGy for PETI5A when irradiated at 300°C.

Thermogravimetric Analysis (TGA) shows us that the thermal decomposition process is 100 times less apparent at 300°C than at 360°C.

References

1. Jensen, B.J. and Hergenrother, P.M. Poly(arylene ether)s with pendant ethynl groups. *Pure Appl. Chem.* **A30**(6 & 7), 449 **1993**.

2. Bryant, R.G., Jensen, B.J. and Hergenrother, P.M. Synthesis and Properties of Phenylethynyl-Terminated Arylene Ethers. *Polym. Prep* **33**, 910 **1992**.