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Synthesis, characterization and thermal properties of novel epoxy containing silicon and phosphorus nanocomposites by solâ€“gel method

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Abstract

Organicâ€“inorganic hybrids were prepared using diglycidyl ether of bisphenol A (DGEBA) type epoxy and tetraethoxysilane via the solâ€“gel process. The DGEBA type epoxy was modified by a coupling agent to improve the compatibility of the organic and inorganic phases. The solâ€“gel technique was used successfully to incorporate silicon and phosphorus into the network of hybrids increasing flame retardance.

Fourier transform infrared spectroscopy and ^{29}Si nuclear magnetic resonance spectroscopy were used to characterize the structure of the hybrids. In condensed siloxane species for TEOS, silicon atoms through mono-, di-, tri-, and tetra-substituted

siloxane bonds are designated as Q^1, Q^2, Q^3, Q^4, respectively. For 3-isocyanatopropyltriethoxysilane and diethylphosphatoethyltriethoxysilane, mono-, di-, tri-, tetra-substituted siloxane bonds are designated as T^1, T^2, T^3. Results revealed that Q^4, Q^3, T^3 are the major environments forming a network structure. The morphology of the ceramer was examined by scanning electron microscopy and Si mapping. Particle sizes were below 100 nm. The hybrids were nanocomposites. The char yield of pure epoxy resin was 14.8 wt.% and that of modified epoxy nanocomposite was 31 wt.% at 800 Â°C. A higher char yield enhances the flame retardance. Values of limiting oxygen index of pure epoxy and modified epoxy nanocomposites are 24 and 32, respectively, indicating that modified epoxy nanocomposites possess better flame retardance than the pure epoxy resin.

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Keywords

Epoxy; Hybrid ceramers; Flame retardance; Silicon; Phosphorus; Nanocomposite; Solâ€“gel technique

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