

عنوان مقاله:

Fracture toughness of epoxy polymer modified with nanosilica particles: particle size effect

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خلاصه مقاله:

An epoxy resin, cured with an anhydride, was modified by the addition of different nanosilica particles. The particles with 12, 20, and 40 nm in diameter, were distributed into epoxy resin with ultrasonic instrument which gave a very well-dispersed phase of nanosilica particles. Electron microscopy showed that the nanosilica particles were well-dispersed throughout the epoxy resin. Tensile test and dynamic mechanical thermal analysis (DMTA) showed that Young's modulus increased as the volume fraction of the nanosilica particles and the glass transition temperature was unchanged. The fracture energy increased from 283J/m² for the unmodified epoxy to about 620J/m² for the epoxy with 3.17 vol% of 12-nm diameter nanosilica particles. The amount of fracture energy for smaller particles is greater that is related to high surface to volume ratio of these particles. The fracture surfaces were checked using scanning electron and atomic force microscopies, and the results were compared to various toughening mechanisms. The toughening mechanisms of crack pinning and crack deflection were discounted and two toughening mechanisms which were operative in the epoxy resin containing nanosilica particles were recognized to be plastic deformation and plastic void growth. Finally, the toughening mechanisms have been quantitatively modelled and an excellent agreement between the experimental and the evaluated fracture energies was found.

کلمات کلیدی:

Epoxy, Nanosilica, Fracture toughness, Toughening mechanisms, Specific surface area

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