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Synthesis and characterization of organic/inorganic hybrids based on epoxy resin and 3-glycidyloxypropyltrimethoxysilane

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The study of organic-inorganic hybrids obtained by sol-gel process became an expanding field of investigation.. The main hypothesis of the research is that hybrid materials, where inorganic phase is very finely dispersed (on molecular or nano level) and often interconnected three-dimensionally with the organic polymer, have superior properties to those obtained via classical routes like blending polymers with inorganic fillers and/or fibers. To obtain organic/inorganic hybrids by the sol-gel process several methods are applied. One of the methods is the simultaneous polymerization of organic and inorganic monomers.
In this work three organic-inorganic hybrid materials based on a thermoset epoxy resin, diglycidyl ether of bisphenol A (DGEBA),. and an inorganic precursor, 3-glycidyloxypropyltrimethoxysilane (GLYMO), were prepared by the sol-gel process. DGEBA and GLYMO were blended in weigh ratios of 1:2; 1:1; and 2:1. Poly(oxypropylene) diamine was mixed into the above blends as curing agent. Curing was effected at room temperature (from 1 to 30 days) making use of air humidity for hydrolyzing GLYMO. The materials were postcured at 120oC for one day. The (post)curing kinetics of investigated systems were studied by means of differential scanning calorimetry (DSC). In addition to DSC, properties of the prepared materials were studied by means of thermogravimetric analysis (TGA), infrared spectroscopy (IR) and swelling in tetrahydrofurane (THF).
A lower total heat of reaction developed during simultaneous polymerization of DGEBA/GLYMO systems in dynamic DSC tests was found , compared to the total heats developed during pure DGEBA and GLYMO polymerization. The influence of the blend composition on the final conversion, on the degree of crosslinking as well as on the equilibrium degree of swelling was discussed. The obtained materials were all transparent. The DSC scanning curves of all postcured materials indicated only one glass transition. From the derivative (DTGA) curve one single peak for all hybrid systems is observed.

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