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MORPHOLOGY AND MECHANICAL PROPERTIES OF EPOXY NANOCOMPOSITES

P. Murias, L. Matějka, J. Pleštil

Department of Polymer Networks and Mechanical Properties, Institute of Macromolecular Chemistry, Academy of Sciences of the Czech Republic, Heyrovského nám. 2, CZ-162 06 Praha 6, Czech Republic (murias@imc.cas.cz)

The organic-inorganic nanocomposites have been synthesized and their structure, morphology as well as mechanical properties were determined. The epoxy network from diglycidyl ether of Bisphenol A (DGEBA) and poly(oxypropylene)diamine (Jeffamine D2000) serves as an organic matrix of the hybrid. The well-defined nanobuilding blocks – polyhedral oligomeric silsesquioxanes (POSS) were used as an inorganic nanofiller. The epoxy- or aminofunctional POSS monomers were incorporated in the epoxy network as blocks pendant on a polymer chain or as network junctions.

The kinetics of the network structure evolution was determined by combination of chemorheology experiments and dielectric analysis. The structure of the organic-inorganic networks was characterized by using SAXS and WAXS. DMA was used to determine the thermomechanical properties.

The organic-inorganic hybrid is a microphase separated system and its structure and morphology were controlled by polymerization procedure and by the type of POSS monomer. The two-step polymerization, consisting in preparation of the adduct of DGEBA and POSS monomer in the first stage, provides an increased compatibility of the reaction mixture and leads to formation of a more homogeneous system. The organic substituents of the POSS monomer govern the strength of the POSS-polymer and POSS-POSS interactions, thus controlling the tendency of POSS to aggregation. While POSS units with phenyl substituents show a strong POSS-POSS interaction and formation of POSS nanodomains within the epoxy matrix, the POSS monomer with isooctyl substituents displays a higher miscibility with the epoxy-amine system and a weaker POSS-POSS interaction. The POSS nanodomains form physical crosslinks in the organic matrix and the strength of POSS-POSS interaction determines the mechanical properties of the system. The polyepoxy-POSS monomers are well dispersed in the matrix as network junctions and the resulting hybrid is homogeneous on the molecular level.

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