Nanocomposites and nanomaterials

Nanocomposites based on semi-IPN and nanofiller modified by aminoacid glycine for biomedical application

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The nanocomposites based on multicomponent polymer matrix consisting of polyurethane (PU), poly (2-hydroxyethyl methacrylate) (PHEMA), and nanofillers based on silica with mechanically activated surface and surface modified by aminoacid glycine are synthesized. The structure of the created nanocomposites and thermodynamic parameters of polymer matrix components interaction with nanofiller were studied.

The structure of the created nanocomposites was investigated by small-angle X-ray scattering and was shown that modification of densil surface by aminoacid glycine leads to an increase of average size of the particles and to the formation of a rough surface of filler. Introduction of modified nanofiller into polymer matrix influenced the structure of the matrix: there is a complete disappearance of the structural features of semi-IPN in the nanocomposites. With the introduction of the modified nanofiller into polymer matrix the mass-fractal of spatial distribution of the particles is preserved. However, the surface roughness of the particles increases because of the surface layer at the interface with the filler is formed, consisting of fragments of the polymer matrix.

The thermodynamic parameters of interaction between polymer matrix and nanofiller during formation of the nanocomposites were investigated. It was shown that the free energy of mixing of polyurethane, poly(2-hydroxyethyl methacrylate) (PHEMA) and semi-IPNs with filler is negative for systems with low content of PHEMA, and thus the energy is released during process of the nanocomposites formation, and dence, durable polymer layers on the surface of nanofiller are formed. With increasing the PHEMA content the free energy of mixing moves to the positive value, which is the result of competition of two processes: the formation of dense surface layers on the surface of the filler, and the formation of interfacial layers with excess free volume.

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