Nanocomposites and nanomaterials

3-D artificial nanodiamonds containing nanocomposites based on hybrid polyurethane-poly(2-hydroxyethyl methacrylate) polymer matrix

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The artificial nanodiamonds (NDs) with particle size of 2-50 nm (produced by high shock blow method) were used as nanofiller for composites based on multicomponent polymer matrix consists of polyurethane (PU) and poly(2-hydroxyethyl methacrylate) (PHEMA). The thermodynamic miscibility, dynamic mechanical, physical-mechanical properties, segmental motions and morphology of composites have been investigated.

The vapour sorption by filled composites and by nanodiamonds was studied, and thermodynamic affinity of polymer components to the filler was estimated. The free energy of interaction between the polymer components and nanofiller was negative, this means that NDs can be considered as the reinforcing nanofiller for the investigated polymer systems.

The mechanical properties investigation have shown that introduction of NDs into polymer matrix resulted in significant growth in stress at break and in Young's modulus. The maximal effect obtained for samples with 0.25% of filler.

Segmental dynamics and elastic properties were studied by CRS and DSC methods, network structure and dispersion/spatial distribution of ND particles were studied by AFM/IRS techniques. The effects of double hybridization, the pronounced dynamic heterogeneity, the anomalous changes in PHEMA glass transition, sharp suppression of dynamics and multifold enhancing elastic properties at only 0.25 wt% NDs were found. It is due to improved dispersion-/distribution of NDs, and the united glass transition, extending from – 60 to 160^{0}C, and these effects are of interest for the biomedical and technical applications.

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