Nanocomposites and nanomaterials

Nanocomposites based on polyurethane /poly(2-hydroxyethyl methacrylate) polymer matrix and nanofiller densil for biomedical application

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The nanocomposites based on polyurethane (PU) and poly(2-hydroxyethyl methacrylate) (PHEMA) semi-IPN and nanofiller densil were created as depo for antiseptics, aminoacids, bioboosters for future biomedical applications. The thermal, dynamic mechanical analysis, morphology and mechanical properties of the nanocomposites have been investigated.

Free energy of polymer-filler interaction in the nanocomposites depends on polymer matrix composition. For PU/PHEMA 83/17 IPN matrix it is negative, indicating the thermodynamic compatibility between matrix and nanofiller densyl. With increasing amount of PHEMA in the matrix the thermodynamic compatibility varies with the content of nanofiller.

By SAXS the uniformly distributed nanofiller at its minimum content (1%), and aggregation of nanofiller in the form of mass-fractal structures with increasing amount of densil was found.

Mechanical properties of the nanocomposites significantly exceed the parameters of the matrix, nonmonotonously change with the content of nanofiller.

The investigation of thermal properties of the nanocomposites have shown two glass transition on DSC curves in according to PU and PHEMA constituence in the semi-IPN. With the increase of filler content and PHEMA ratio in the samples the glass transition temperature of PU did not change significantly, but it was a non-linear decrease of the heat capacity jump ΔCp of PU from 0.56 to 0.26 and ΔCp of PHEMA from 0.31 to 0,056.

The DMA spectra of nanocomposites with different content of filler (from 3 to 15%) have two distinct maxima of tan δ, indicating two phases systems. The intensity of PU and PHEMA maxima of tan δ significantly lower in the nanocomposites in compare with native matrix due to formation of strong interphases layers on the surface of nanofiller and restriction of segmental motions.

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