Nanocomposites and nanomaterials

Nanocomposite hydrogels filled with mineral nanoparticles

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Cross-linked nanocomposite hydrogels based on copolymers of acryl amide and mineral nanoparticles (NP) of diverse nature (hydroxyapatite (HAP), ZnO, TiO_2, CdS) were synthesized via two different techniques.

Nanocomposite hydrogels filled with semiconductor CdS NP were obtained using sol-gel synthesis of nanoparticles in cured hydrogel matrix. Polyacrylamide hydrogels containing bonded Cd^{2+} ions were exposed to gaseous H_2S that resulted in transparent yellowish nanocomposite formation. UV-vis spectroscopy proved formation of CdS nanoparticles with an average size of 4-6 nm. NPs size decreased with increasing degree of the hydrogel curing; that witnessed in favour of our assumption about their formation in the cells of the cross-linked hydrogel.

Nanocomposite hydrogels filled with NP of HAP, ZnO, TiO_2 modified by reactive polymers were synthesized via the technique of polymerization filling. As a result of NP modification by peroxidic modifiers mineral nanoparticles with thin adsorption polymer layer were obtained, peroxidic fragments of which are able to initiate radical processes. Modified in such a way NPs were used as filler-initiator during the synthesis of nano-structured poly(acryl amide) hydrogels. As a result, cross-linked nanocomposite hydrogels with curing degree from 50% to 97% were obtained depending on NP modifier nature and content of additional cross-linker – N,N' methylene-bis-acryl amide (MBA).

The dependence of colloidal-chemical and physico-mechanical properties of nanocomposites on it composition were studied. So, the ability to water-swelling of the samples filled by ZnO is higher than in the case of TiO_2. This can be caused by smaller size of TiO_2 nanoparticles. At the same weight content of peroxidized filler this caused the increase of the quantity of cross-linking centers and as a result the formation of hydrogel with higher curing degree. The results of the study of physico-mechanical properties of obtained hydrogels with embedded TiO_2 and ZnO NP are in a good agreement with the data obtained at the study of hydrogel swelling ability – with the increase of MBA concentration the tensile strength increased with simultaneous decrease of elongation at break that can be explained by the enhancement of curing density and rigidity of polymer hydrogel.