

Polymer-nanodiamond composites

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Polymer-based filled with particles composite materials are widely used in the modern industry and technologies, including nanotechnologies, thanks to their light processing into final products.

Among other species, the promising components for the polymer nanocomposites are nanodiamond (or inexpensive in production nanodiamond soot) prepared by the detonation synthesis (ND and NDS) [1]. ND and NDS can be used as effective modifying agents providing improved mechanical or tribological characteristics of the filled polymer systems.

The objective of this study was to examine the structure and properties of the new type of polymer/ND(S) composites and to investigate the possibility of the nanocomposite morphology, structure and properties regulation under controllable loading of the nanoparticles into polymeric matrix.

Poly(vinyl alcohol) as well as commercially produced polybutadiene/polystyrene thermoplastic elastomer DST-30®, poly(propylene), poly(amide) and epoxy resin were used as matrix polymers for nanocomposites. The ND and NDS were supplied by JSC "Diamond Center", St. Petersburg, Russia. SAXS, WAXS, DLS, DSC, SEM, TEM, mechanical and tribological testing were used for samples characterization.

For the oriented fibers based on poly(vinyl alcohol) impregnated with ND(S), the maximum increase in the longitudinal elastic modulus over nonmodified fibers (from 30 GPa up to 45 GPa) and in the energy stored by oriented fiber modified with NDS upon breaking (from 3 up to 6 J/g) was obtained at a small (1% by volume) NDS content, which is technologically attractive [2]. For thermoplastic elastomer/NDS composites, the addition of NDS had a significant influence on the mechanical properties of the modified polymeric matrix [3].

Finally, some problems of current importance and unresolved tasks are considered in connection with a global task of polymer nanocomposites design.

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