Effect of Nanodiamonds and Ultradispersive Diamond Soot on Mechanical Properties of Poly(vinyl alcohol) Fibers

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Mechanical properties of high-modulus nanocomposite poly(vinyl alcohol) (PVA) fibers containing various amounts of detonation nanodiamonds and ultradispersive diamond soot were investigated and compared to those of unmodified PVA fibers. The main efforts were focused on the analysis of stress-strain curves obtained for all kinds of fibers under the same conditions and on the preservation of high-level dispersion of the fillers.

The nanocomposite fibers containing of about 3, 6 and 12 vol.% of nanodiamonds, as well as fibers modified by approximately 1 and 2 vol.% of diamond soot were prepared via dry-wet spinning method [1]. The absence of aggregation of the fillers was verified by comparing the SAXS patterns obtained for nanocomposite material and those obtained for the reference suspension, that is nanodiamonds/diamond soot dispersed in a mixture of dimethyl sulfoxide and water.

It has been proven, that the impregnation of PVA fibers with 6 vol.% nanodiamonds results in a significant increase of the Young modulus, with its value being 37 GPa and tensile strength (defined as a stress at break) being 1650 MPa. The respective values for the reference unmodified fiber are obtained to be 29-30 GPa and a tensile strength of approximately 1500 MPa. The embodiment of ultradispersive diamond soot results in a more significant increase of mechanical properties. With the concentration of diamond soot being as low as 2 vol.% the Young modulus of composite fiber increases up to 45-49 GPa. As a reference, the Young modulus of PVA fiber containing nearly 3 vol.% nanodiamonds was only 32-33 GPa.

The obtained results suggest the ultradispersive diamond soot to be an effective low-cost modifier for the mechanical properties of industrial high-strength and high-modulus polymer fibers.

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[1] T.S. Kurkin, A.N. Ozerin et al. *Polymer Science, Ser. A*. **50**(1), 43 (2008).