Composite nanomaterial based on protein and multiwall carbon nanotubes

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The optical and mechanical properties of bulk composite nanomaterials (BCNM) based on bovine serum albumin (BSA) and multiwall carbon nanotubes (MWNT) are investigated.

For the synthesis of MWCNT used was bimetallic catalyst Fe-Mo/MgO. Synthesis of MWNT at 900°C took place in a stream of Ar and CH_4 for 40 minutes. After synthesis the material was subjected to multi-step chemical processing, which resulted in sticking of the functional groups to MWCNTs (func.), enabling the formation of stable aqueous suspensions. Proportion of MWCNTs in the final material after treatment was 95±1 wt. %.

In 25% aqueous solution of BSA were added the MWCNTs, MWCNT (func.) in the interval (0.004-0.1) wt.%, while for the control samples added was black K-354 in the same proportions. Suspensions of BSA+MWCNT, BSA+MWNT (func.), BSA+black were obtained after mechanical and ultrasonic stirring and decanting.

There were established the following absorption coefficients at a wavelength of 970 nm: for BSA solution – 0.004 mm^{-1}, for a suspension of MWCNT (func.) – 0.06 mm^{-1}, of BSA+black – 0.4 mm^{-1}, of BSA+MWCNT – 0.17 mm^{-1}, of BSA+MWNT (func.) – 1.1 mm^{-1}. Higher absorption coefficient in suspensions of BSA+MWCNT (func.) were caused by many factors, perhaps including their high uniformity and the increase in defectiveness of MWCNT (func.) during functionalization.

Solutions and suspensions were exposed to the laser radiation at wavelength of 970 nm in different modes (pulse, continuous) while varying levels of power and exposure time. The hardness of the samples was measured by Vickers.

The studies have shown that the maximum hardness (220-320 MPa) BCNM is 3-5 times higher than that of the dried BSA and BSA+black and is at the level of hardness of human bone tissue (~ 500 MPa).