Nanocomposites and nanomaterials

Composite materials filled with carbon nanotubes

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Multiwall carbon nanotubes (CNTs) are characterized by extremely high specific strength properties (tensile 1.8 TPa), electrical and thermal conductivity. A property that differs CNT from another nanoparticles is a unique high aspect number () (ratio of length to diameter) more than 10^3. That is why, a percolation threshold () (1/), i.e. the concentration at which a continuous network of CNTs formed in the matrix of polymer at homogeneous distribution, is equaled to 0.1% wt. Therefore, CNTs show high efficiency reinforcement in matrices of different nature.

CNTs have been obtained by the CCVD (catalytic chemical vapor deposition) method by pyrolysis of ethylene, propylene or propane - butane with application of metal oxides catalysts. The average diameters of CNTs were 10–20 nm, specific surface area determined by argon desorption was 200–400 m^2/g, and bulk density was within 20–40 g/dm^3. According to TEM, X-ray diffraction, Raman spectroscopy data, the noticeable amount of amorphous carbon presence was not detected.

CNTs agglomerates have been disintegrated by ultrasonic method and rotary homogenizer based on the simultaneous effect of shear deformation and cavitation mixing in an aqueous solution of ionic surfactants or ethyl alcohol. Analysis of agglomerates status was carried out by laser correlation spectroscopy. It has been found that a size of agglomerates are reduced from 20-500 mkm to 150-300 nm.

It was shown that insertion of carbon nanotubes (CNT) in different matrixes, such as polymers, hydroxyapatite (HAP), elastomers and liquid Selenium, leads to significant changes of their parameters. Extremely small concentration of CNTs has changed significantly a degree of crystallinity of PTFE, polypropylene, polyethylene. It has increased mechanical and kinetic characteristics, temperature of thermo-oxidative degradation. This indicates a rather strong interaction of CNT with the polymer matrix. During the solidification of the liquid system selenium-CNT, it has observed completely amorphous state compared to polycrystalline metals in the case of selenium. CNTs reinforcement of HAP ceramics have led the structure to streamline and nonmonotonic increase in strength characteristics due to the formation of a continuous network of CNTs in the original matrix.

We demonstrate improve both volume characteristics and surface properties of filled composites explaining by it a better biocompatibility of nanocomposites, observed *in vivo* experiment in medical application [1].

1. Sementsov Yu.,Prikhod'ko G., Kartel N., etc. Carbon nanotubes filled composite materials In book:

“Carbon Nanomaterials in Clean Energy Hydrogen Systems” NATO Science for Peace and Security Series C: Environmental Security. Springer Science + Bussines Media B.V., 2011.- P.183-195.