Influence of liquid-phase oxidation treatments on the purity and hydrophilicity of single-walled carbon nanotubes

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The practical use of single-walled carbon nanotubes (SWCNTs) is hindered by the fact that it is impossible to synthesize them pure (without amorphous carbon and impurities of the catalytic synthesis phase), not subjected to aggregation into bundles during the synthesis process and capable of being dispersed into individual molecules in polar solvents. In this work, we investigated the effect of liquid-phase oxidative treatments on the purification of SWCNTs from organic and inorganic impurities, their structural modifications with oxygen-containing groups for the formation of stable suspensions in polar solvents [1]. The following oxidizing reagents were used: hydrogen peroxide with following treatment of SWCNTs with hydrochloric acid or a mixture of concentrated acids (HNO_3/H_2SO_4) [2]. Treatments were carried out at 105-115 ^{0}C for 1 h using preliminary ultrasonic loosening of SWCNT bundles in surfactant solutions [3]. Finishing substances were studied for their ability to disperse in water, isopropyl alcohol and their mixtures. The structural features of SWCNTs, initial and subjected to oxidative treatment, were studied by transmission electron microscopy, Raman spectroscopy and infrared absorption. Their elemental compositions was studied by X-ray energy dispersive method. Studies have shown that bundles of SWCNTs, due to the adsorption layers of surfactants, are separated without destructive effects on the SWCNT structure when using treatment with an HNO_3/H_2SO_4 mixture (2: 1, vol.). This contributes to the formation of an array of SWCNTs, purified from amorphous carbon and inorganic impurities (the content does not exceed 1.0 wt.%), dispersible in water and an aqueous-alcoholic solution (9 : 1, vol.) with the formation of concentrated and stable suspensions. TEM images of SWCNTs are shown in the Fig.

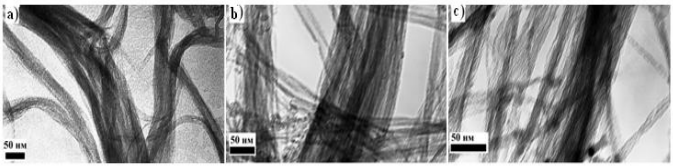

Fig. TEM images of SWCNTs: a − initial, b, c − after treatments respectively in solutions of H_2O_2 and HNO_3/H_2SO_4.

References

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