Electrochemical functionalization of carbon single-walled nanotubes

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An electrochemical method of modification of carbon single-walled nanotubes (SWNT) at superposition of anodic potentials in aqueous solutions of potassium bromide is proposed. This process is shown to be accompanied by a considerable increase in the capacity of SWNT electrodes. Capacity increase is assumed to be connected with the increase of the surface of nanotube electrode accessible for electrolyte solution what is caused by the forming of functional groups on SWNT surface.

X-ray photoelectron spectroscopy method (XPS) was used to the establish nature of functional groups grafted to nanotube carbon during the electrolysis. Considerably greater intensity of peaks of Br and O shown to be characteristic feature of obtained spectra of electrochemical treated samples in comparison with initial SWNT. As follows from XPS data oxidation of SWNT surface at the electrolysis of potassium bromide is shown to be the main route of functionalization to be not their halogenation. Thus, after electrolysis four atoms of carbon correspond to one oxygen atom. At the same time thirty carbon atoms conform to one bromine atom lying surface of nanotubes.

Based on the obtained data, it is to propose a mechanism of electrochemical treatment of SWNT upon the bromide ion electrolysis. At the first stage, unstable hypobromite ion is formed as a result of the interaction of bromine, evolving at electrolysis, with water. At the same time results of chromatography-mass spectrometry show that part of hypobromite ion disproportionates on hypobromate ion. Atomic oxygen evolving at decomposition of hypobromite and hypobromate ions oxidizes nanotube surface with the formation of functional groups.