Carbon nanotubes-DNA hybrids: structures and properties

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Bionanohybrids formed by single-walled carbon nanotubes (SWNT) and DNA attract the particular interest of scientists due to their promising application for creating the new generation biosensors. In this report our study of the physical properties of carbon nanotubes hybrids with single- and double-stranded polynucleotides as well as fragmented genomic DNA is reviewed. We have simulated a hybrid formed by the wrapped DNA around SWNT in water by molecular dynamic modeling. As a result the different structures of polymers adsorbed to the nanotube surface were obtained [1]. AFM demonstrated the different SWNT:DNA hybrids which were deposited the mica substrate from aqueous suspension. Because the polymer interacts mainly with tube surface through nitrogen bases we studied such hybrid structures by Raman spectroscopy and DFT calculation and determined energy interaction between them [2]. We employed also near IR luminescence and resonance Raman spectroscopy to control SWNTs in hybrids and the UV absorption spectroscopy to observe DNA structure transformation after adsorption on the nanotube surface. Our study a hybridization of the free polynucleotide poly(rU) with complementary poly(rA) adsorbed to the SWNT surface in aqueous suspension indicates that hybridization on the SWNT surface occurs with defects because of essential π-π stacking interaction between nitrogen bases and the nanotube surface, which hinders the usual hybridization process [3].

The possible applications of SWNT-DNA are discussed, first of all, using this bionanohybrid as nanosized element of biosensor, for example, as genosensor or glucose-sensor. We shall demonstrate that DNA can serve as an interface between the enzyme and nanotube to keep the enzyme activity, which usually decreases when the enzyme is directly adsorbed to the nanotube [4].

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