

Spectroscopic Investigations of Carbon Nanotubes in Aqueous Suspensions with Biosurfactants

V. Pashynska¹, A. Glamazda¹, A. Plokhotnichenko¹, E. Karpenko²,
T. Pokynbroda², V. Karachevtsev¹

¹B. Verkin Institute for Low Temperature Physics and Engineering of the National Academy of Sciences of Ukraine, 47, Lenin Ave., Kharkov, 61103, Ukraine, pashynska@ilt.kharkov.ua, ²Lviv Department of Physical-Organic Chemistry Institute, National Academy of Sciences of Ukraine

Application of carbon nanotubes in medicine, pharmacology and biotechnology belongs to the prospective areas of nanoscience and nanotechnology. The ideas of nanotubes utilization for directed transport of medicines in human organism and using nanostructures as parts of bionanosensors are under intensive investigation now. One of the crucial problems limiting nanostructures application for medical purposes is a weak solubility of carbon nanotubes in water and other polar solvents. To solve this problem surfactants of different types are utilized. Application of biosurfactants (natural surfactants) for nanotubes dilution in biorelated experiments has some advantages because of non-toxicity, high efficiency and biodegradability of the biosubstances that allows increasing a nanotubes biocompatibility.

In present work an efficiency of two rhamnolipid biosurfactants for promotion of single-walled nanotubes (SWNT) dilution in water was investigated by spectroscopic methods. These mono- (RL1) and di- (RL2) rhamnolipids were produced naturally by bacterial strain *Pseudomonas sp. PS-17* as extracellular surface-active substances. The biosurfactants were extracted from the bacterial supernatant by the method described in [1].

Steady aqueous suspensions of SWNTs were prepared by sonication of nanotubes bundles with biosurfactants for 40 minutes (1 W, 44 kHz). Then the solutions were centrifuged at 15000 g for 15 min, and the supernatants were decanted and recentrifuged at 60000 g for 40 min. The initial nanotubes concentration was 0.1 mg/mL. Biosurfactants concentration was 1%. After ultracentrifugation the supernatants were decanted and these homogenous suspensions were stable for a month. For reference the nanotubes aqueous suspension with non-biosurfactant (sodium dodecylbenzenesulfonate (SDBS)), which demonstrated high efficiency of individual nanotubes dilution, was prepared too.

The light absorption spectra of SWNT:RL1, SWNT:RL2 and SWNT:SDBS aqueous suspensions in the UV-visible-near infra-red region (300-1500 nm) were obtained. In spite of the lower concentration of SWNTs in the suspensions with biosurfactants in comparison with the SWNT:SDBS suspension the observed spectra of SWNT:RL1, SWNT:PL2 systems testify to a presence in the suspensions individually dissolved nanotubes. Among two biosurfactants RL2 provides higher nanotubes concentration in aqueous suspension that is evidence of the higher RL2 efficiency in the SWNT dilution process in comparison with the RL1 one. Similar results were obtained by the investigation of luminescence spectra of the systems studied. The bands in the spectrum of SWNTs:RL2 shifted to the low energy area in comparison with the SWNTs:SDBS spectrum. This shift can be explained by the less partial covering of the nanotubes surface by RL2 molecules comparing with SDBS ones that results in increase of water-nanotube contact area in SWNT:RL2 system and correspondent spectrum features. The difference in the efficiency of RL1 and RL2 for nanotubes delution is discussed.

[1] E.V. Karpenko, N.B. Martynyuk, A.N. Shulga, Surface active biopreparations, Patent of Ukraine N 71792, Bull.N 12, 2004.