Photoluminescence enhancement from semiconducting carbon nanotubes due to amino acid doping: influence of the polymer coverage and the external conditions

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The quantitative analysis of amino acid levels in the human plasma or urine has important for the investigation of cellular functions and for the early clinical diagnosis of a variety of diseases. The photoluminescence (PL) from semiconducting carbon single-walled carbon nanotube (SWNT) is very sensitive to an environment and can be employed for various applications including biological sensors and imaging applications.

In the present contribution the results of the experimental investigation of the influence of doping with thirteen amino acids on PL from ssDNA-wrapped nanotubes in aqueous suspension are presented. PL spectra of SWNTs were observed in the range of 1.1-1.6 eV (λ_{ex}=532 nm, 5 mW). After amino acids doping the nanotube PL was enhanced and the strongest PL enhancement was found after cysteine doping (up to 22 % at 10^{-3} M) [1]. Most likely, the PL intensity increases due to the passivation of p-defects on the nanotube sidewall by the cysteine molecules containing reactive thiol group. The effect of doping with other amino acids without this group on the PL intensity is essentially weaker (the PL enhancement does not exceed 4%). So, we can conclude that presence of thiol group in cysteine structure is crucial for its influence on the nanotube PL intensity.

We also studied the effect of several external factors on the cysteine-induced enhancement of PL from nanotubes covered with DNA: type of sonication treatment of the suspension (tip or bath), the ionic strength and pH of suspension, UV irradiation. It turned out that these factors have an essential influence on the dependence of the PL enhancement on the cysteine concentration. We suppose that mentioned external factors have an influence on the nanotube PL through an appearance of additional defects on the nanotube surface as well as a change of the nanotube coverage with polymer. The influence of weight ratio nanotubes:DNA before suspension preparation as well as coverage of SWNTs by other biopolymer on this dependence is considered too. Thus, we have demonstrated that PL from SWNTs can be exploited successfully for the monitoring of cysteine concentration in aqueous solution in the range of 50–1000 μM.

1. *Kurnosov N.V., Leontiev V.S., Linnik A.S., Karachevtsev V.A.* Influence of cysteine doping on photoluminescence intensity from semiconducting single-walled carbon nanotubes // Chem Phys Lett. -2015. -**623,** -P. 51–54.