

NANOCOMPOSITES OF DETONATION NANODIAMOND WITH FLUORESCENT MEROCYANINE DYES

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Abstract. In the field of biomedical research, it is an important problem to increase the sensitivity of fluorescent methods of analysis for controlling selectivity of distribution in the tissues of the organism of biologically active agents injected as part of drug delivery systems. Detonation nanodiamonds (DNDs) are a perspective basis for nanocomplexes for biomedical applications, having low toxicity, high biocompatibility and possibility of surface composition modification. With a size less than 100 nm, DNDs are able to cross into body cells without cyto- and genotoxic effects, thus allowing to create complexes with drugs and biomarkers on their platform. Therefore, application of DNDs with fluorescent dyes used as markers for a different biomolecule increases the sensitivity of the analysis and allows controlling the biodistribution of the active substance. In the present work has been developed synthesis of complexes DNDs with fluorescent dyes, which can be used in the field of biomedical applications, has been studied their optical properties. Monofunctionalized DND powders of two types - nanoparticles with surface OH-groups and with a hexamethylethylenediamine linker with a terminal NH₂-group - were used as the basis for the complexes [1]. A number of merocyanine dyes with different polymethine chain absorbing in different spectral ranges were selected for modification of DND. In this way, 4 samples were synthesised - conjugates of mono- and dicarbocyanine dyes with DND-OH and DND-NH₂ [2]. The Mikayama's reaction allows the preparation of esters and amides under mild conditions (24 h, 25 °C) due to specific activation of the carboxyl group of C dyes by N-bromopyridinium mesylate in dimethylformamide (DMF) environment in the presence of N-methylmorpholine. The resulting suspension of DNDC conjugate is repeatedly centrifuged and dispersed in solvent in order to extract the dyes from the reaction mixture and then dried. Mass fraction of dyes of the obtained powders of nanocomplexes is 5%. Changes in the composition of powders during modification and grafting were confirmed by IR spectroscopy and electronic spectra. The influence of interaction with the surface of DND on the fluorescent properties of dyes requires additional study and is the subject of further research.

REFERENCES

1. Gusakov G.A., Lugovski A.A., [et al.], *Journal of Applied Spectroscopy*. 87, 2020, pp. 33-42.
2. Pligin E.V., Lugovski A.A., [et al.], *Journal of Applied Spectroscopy*. 89, 2023, pp. 1021-1028.