Development and investigation of drug delivery system based on the detonation nanodiamonds

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The method of covalent binding of drugs with detonation nanodiamonds (NDs) was developed. It was shown that such basic methods of NDs modification as oxidation, reduction, halogenation and amination significantly influenced on their properties: dispersion, chemical composition and the density of grafted molecules. It should be mentioned that the derivatives produced by oxidation in gaseous and in liquid phases possess different properties. Variation of NDs reduction conditions let us simultaneously solve not only the problems of purification, disintegration and unification (lesser heterogeneity) of their surfaces but also gives us the possibilities to directionally change their chemical composition.

On this basis the modified NDs with tritium label and X-ray contrast substance were synthesized as well as systems of antibiotic and central neuromediator delivery. The physical and chemical properties of these substances were studied by different methods of electron microscopy (TEM, HRTEM, SEM, confocal), spectroscopy (IR, Raman, XPS, ICP-MS), XRD, DSC, DLS, radiometric analysis, etc. The particles of modified NDs were found to have of disturbed carbon shells up to 1 nm and can consist also chemisorbed molecules. The methods to estimate the number of grafted drug molecules to the NDs' surface were developed. The diffusion through the synthetic and natural (inverted rat's intestine) membranes of original and modified NDs of different dispersion was studied with/without ultrasonic treatment. Biodistribution of modified NDs was studied with rats and rabbits using different insertion ways. To this end X-ray computer tomography, mass-spectrometry and tritium tracer method were used. This work is a part of our preclinical trial of the drug delivery systems on the basis of detonation NDs created by us for the first time.