STRUCTURAL STUDIES OF NANODIAMONDS MODIFIED WITH SURFACTANT IN DIMETHYL SULFOXIDE

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The applications of detonation nanodiamonds (DND, size ~4.5 nm) have not yet been fully defined. Recent publications consider DND as a promising filler in polymer composites [1], a slow-neutron reflector [2], a carrier for targeted drug delivery [3], and a contrast agent for magnetic resonance imaging [4]. For most applications, it is necessary to obtain stable DND sols in organic solvents and, as demonstrated by the complex fractal structure of electrostatically stabilized hydrosols, to conduct systematic studies of such systems using small-angle neutron scattering (SANS) [5,6]. Of particular interest for organic synthesis and medicine is dimethyl sulfoxide (DMSO), a solvent with unique dissolving power and the lowest toxicity among polar aprotic solvents.

Previously [7], we proposed a method for the steric stabilization of diamond nanoparticles in DMSO by binding the surface carboxyl groups of DND with the cationic surfactant cetyltrimethylammonium bromide (CTAB). The systems obtained in this way were shown to have an average size of diamond aggregates of ~27 nm.

In this work, SANS was used to study sols of diamond nanoparticles modified with both CTAB micelles and free CTAB molecules. The measurements were performed on the YuMO spectrometer (IBR-2 reactor, JINR) using protonated and deuterated DMSO for isotopic contrast variation. Sols of carboxylated DND in light and heavy water served as reference samples.

It is shown that the structure of the formed particles does not depend on the modification method. According to the Guinier approximation, the radii of gyration of diamond aggregates in all the samples are ~14−15 nm. DND-CTAB particles in DMSO form fractal structures, but with a lower fractal dimension (D_f = 2.2) than that of hydrosols (D_f = 2.5), which indicates their greater branching.

The obtained results complement the understanding of the internal structure of systems formed by diamond nanoparticles in DMSO and water. This finding is important for the development of new colloidal materials for biomedical applications.

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