THE INFLUENCE OF THE SURFACE FUNCTIONAL GROUP COMPOSITION ON THE SEDIMENTATION STABILITY OF NANODIAMONDS IN AQUEOUS SUSPENSIONS

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Detonation nanodiamonds are scientifically interesting for several reasons: 1) in the recent years, interest has grown toward the problem of synthesizing diamond nanoparticles retaining a constant size in aqueous suspensions; 2) there is no single comprehensive study that would explain the aggregation mechanism of ultradispersed diamonds (UDD) in aqueous environment, although there are several versions; 3) With the accelerated growth of technological progress, it is important to use various modern methods to control and analyze particle size in order to obtain a stable aqueous suspension.

We present on the influence of the functional group composition of the nanodiamond surface on the stability of their aqueous suspensions.

It is known that the primary particles of UDD (4-6 nmin size) tend to form aggregates with particle sizes from 10 nm to several microns. The nature of these aggregates is still not completely clear. The aggregation of diamond nanoparticles can be due to the formation of hydrogen bonds, dipole-dipole or weak van-der-Waals interactions between the functional groups of adjacent UDD particles.

The aggregation of particles can occur in the process of their separation from the diamond batch. The formation of aggregates depends on many factors, including various conditions of the UDD synthesis, purification, and processing methods. In order to determine the aggregation of the UDD powder, new original techniques are being developed.

It is known from the literature that in the widely distributed laboratory studies of nanodiamonds, mechanical, physical, and chemical methods are used to deaggregate them based on existing ideas about the UDD structure [1].

As the object of this study industrial detonation nanodiamonds of the UDA-SP brand in aqueous suspensions were used. The functional group modification on the UDD surface was achieved by the vacuum annealing in the temperature range of 500-1100^0 C, as well as air annealing at 430^{0}C.

It was shown that all types of temperature treatment studied affect the behavior of UDD in aqueous environment. From the IR absorption spectra, it follows that carboxyl groups are removed from the nanodiamond surface by vacuum annealing, while air annealing promotes formation of cyclic anhydrides by oxidizing carboxyl groups.

Carboxyl groups form hydrogen bonds responsible for UDD agglomeration; therefore, for more efficient dispersion in an aqueous medium, preliminary vacuum or air annealing can be applied, since it inhibits formation of the hydrogen bonds between nanodiamond particles.

[1] R.U.Yakovlev, Detonation nanodiamond as a perspective medium biological active substances (Ryazan,2016)