Effect of physical-chemical treatments on the aggregative properties of nanodiamond of detonation synthesis

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Results of studies of kinetics of aggregation of nanodiamond powders depending on the time, temperature and pH of medium (solution) are considered in this report.

It has been ascertained that the rate of aggregation of freshly-mixed suspension is so great that during 10 sec the near 90% (mass) of nanodiamond are aggregated. As temperature increases the aggregation rate increases as well. The rate of aggregation depends on the pH of solution. Alkalization of solution results in the reduction of aggregation rate due to the dissociation of the oxygen-containing compounds of surface layer.

Theoretical explanation of mechanism of aggregation has been proposed. Aggregation process has same phases: 1) adsorption of oxygen-containing groups from solution, 2) generation of functional cover, 3) adjustment of equilibrium between solution and functional cover, 4) agglomeration due to Van der Waals forces (bonding), 5) agglomeration due to covalent (chemical) bonds.

Effect of low-temperature cooling (freezing) of nanodiamond suspension (water) on the physical-chemical and physical-mechanical properties of nanodiamond was studied. It has been ascertained – for the first time – as a result of freezing the displacement of oxygen-containing groups from surface of nanodiamond is progressed. Agglomerates grow up– by 25 times – and physical-mechanical characteristics of it's is improved, apparently, due to the forming of double bonds (C=C) between surface atoms of distinct particles of nanodiamond.

Effect of proportion of carbon of sp^2 and sp^3 hybridization in nanodiamond on the aggregation of the powder was studied. As portion of non-diamond carbon in nanodiamond increases the average diameter of particles increases as well, i.e. agglomeration takes place.

Effect of thermochemical and electrochemical reconstruction of nanodiamond surface on the chemical composition and aggregation of the powder was studied. Thermochemical reconstruction of surface results in the downsizing of average diameter more than by 2 times.