УДК 666.233

# INFLUENCE OF DIFFERENT FACTORS ON NANODIAMOND HYDROSOLS COAGULATION

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The analysis of laws of nanodiamond hydrosols coagulation is important for various applications of aggregate stable nanodiamond dispersions and dispersed phase separation from a dispersion medium during concentrating and refining of process fluids.

To study the process of coagulation methods to measure the number of particles and its change during the coagulation are commonly used. In case of nanoparticles the indirect estimate of coagulation velocity is widely spread. It is based on the monitoring dispersity absorbance *D(t)* or turbidity dynamics in the coagulating system. In the present work the single-beam spectrophotometer has been used to measure nanodiamond aqueous suspensions' absorbance.

The research material used was 0,1% nanodiamond aqueous suspensions. It was produced by three-minute ultrasonication at 22 kHz. The nanodiamonds were made by detonation synthesis – detonation nanodiamonds (DND). Produced on the CSC SB RAS and SFU joint section the nanodiamonds cleaned from non-diamond carbon by heat treatment in the air in the presence of boron trioxide $B_2O_3$ were studied. Such sols were shown to be sedimentation stable in the absence of electrolytes for a long time. The average particles size or their solid aggregates in the aqueous medium is 13 nm. The size of most particles ranges 10 to 100 nm (disk centrifuge CPS 24000).

Suspensions' absorbance was measured at the 330 nm light length. Distilled water was used as a reference sample. The nanodiamond hydrosols' absorbance was measured with potassium chloride KCl solutions of 0,15 M, 0,2 M and 0,3 M concentrations. According to the calculations of particles interaction energy, based on the Derjaguin-Landau-Verwey-Overbeek's theory (DLVO), the potential barrier, which prevents particles aggregation, is completely suppressed at these electrolyte concentrations. The calculations of particles aggregation degree were made by using the average absorbance values of two experiments carried on at the same potassium chloride concentration and similar temperatures. The reproducibility of measurements results was very high – Fig.1.

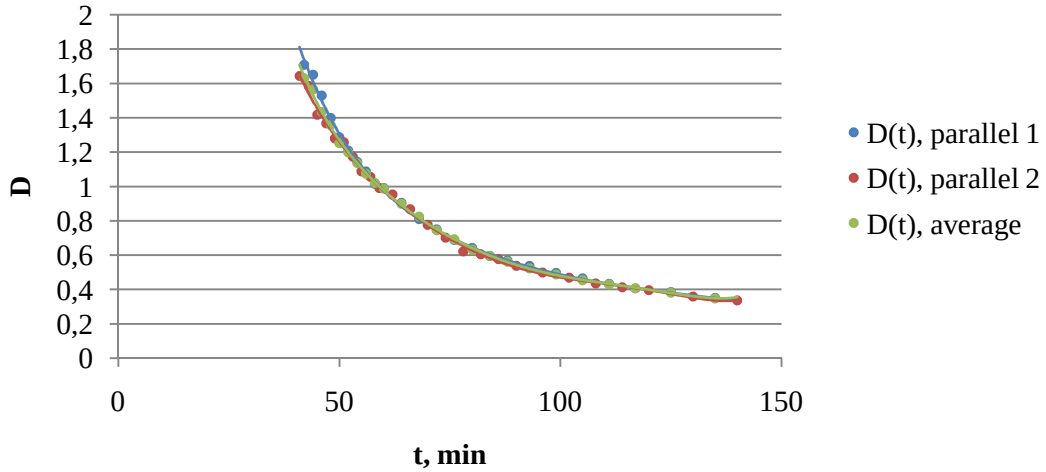


Fig. 1 – Dynamic of nanodiamond hydrosols' absorbance in the presence of KCl at the 0,30 M concentration (T = 298 K)

The change of absorbance with time taking into account aggregates polydispersity allowed calculating the comparative aggregation degree *v(t)* (according to the Ovcharenko A.G.' article «Electrophoretic behavior of aggregates of ultradispersed diamond particles», Colloid Journal, v. 53, №6, 1991).

Fig. 2 illustrates data for DND suspensions with KCl supplemented concentration up to 0,2 M and 0,3 M. The graph shows that the higher the electrolyte concentration is, the faster the coagulation process goes. In spite of the DLVO calculations, the increase of the electrolyte influence on the compression of DND' electrical double layer in suspension occurs.

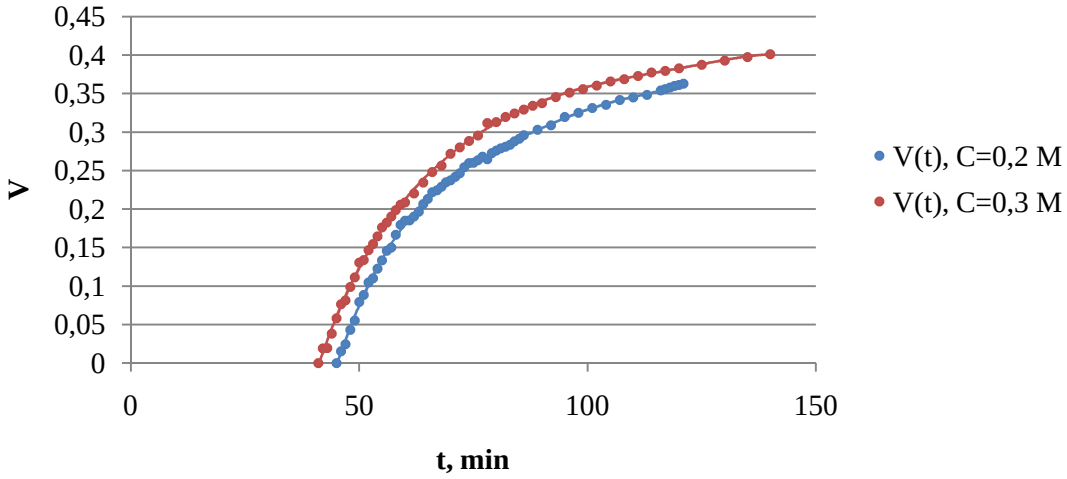


Fig.2 – Calculating results of comparative aggregation degree for nanodiamond hydrosols in the presence of KCl at the 0,2 M and 0,3 M concentration

Fig. 3 illustrates data for the same DND suspensions added with equal KCl concentration 0,15 M at the different temperatures. The graph shows that the lower the ambient temperature is, the later the coagulation process appears. That can be explained by the following: in the absence of the electrostatic stability factor the coagulation of the DND is determined by their collision which directly depends on the temperature.

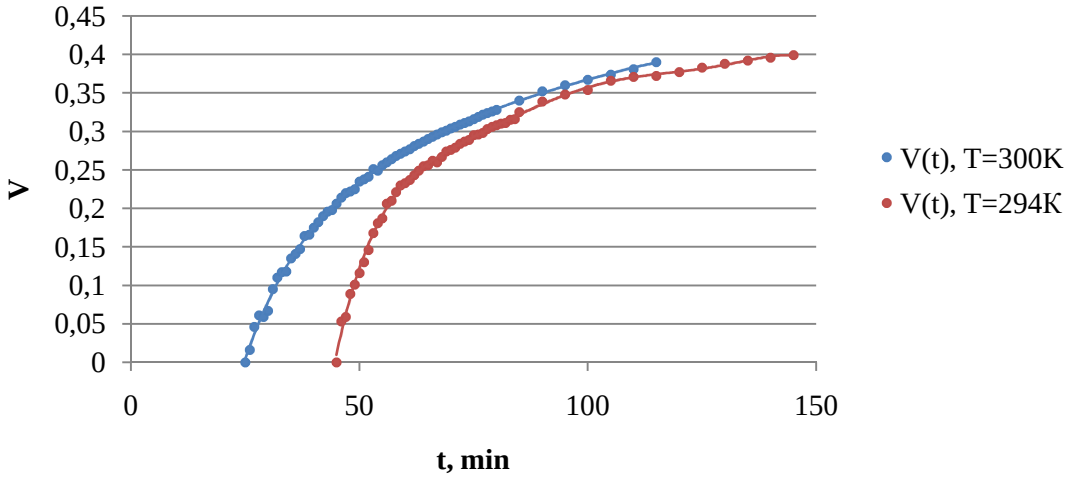


Fig.3 – Calculating results of comparative aggregation degree for nanodiamond hydrosols in the presence of KCl at the 0,15 M concentration at the two different temperatures

The comparison of the experiment results and DLVO calculations of interaction energy between particles of DND allows assuming the existence of the additional factor of hydrosols aggregative stability. The suggestion about the hydration shell effect on the DND surface can be confirmed by the coagulation reversibility when removing electrolyte.