Nanostructured surfaces

Relationsheep between structural-strength properties and cluster formation of highly filled suspensions

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Developing of modern electronics leads to dimensions downsizing of the devices. In this connection there was a necessity to decrease the films thickness and surface parameters values for the most multilayered nanocomposites. Therefore, thinning nature investigation is more promising rout for obtaining objects with prescribed properties.

Highly filled suspensions have been prepared by using of $BaTiO_3$ nanopowder with mean particle size about 20 - 25 nm; ethyl cellulose as binder, dibutyl phthalate (DBP) as plasticizer and terpineol as solvent. It was established that all investigated pastes showed predominantly pseudoplastic flow character. Moreover, plasticized systems successively were in different structure states: «pseudoplastic rheopexic –pseudoplastic – pseudoplastic thixotropic», «pseudoplastic – pseudoplastic thixotropic», «pseudoplastic rheopexic - pseudoplastic thixotropic», «pseudoplastic thixotropic». Obviously, it was connected with changing of polymer molecule conformation due to adsorption type between polymer molecule and $BaTiO_3$ nanoparticle. Consequently, adsorption type changing determines structure type and viscosity of system.

Also, the presence of certain structure states could be explained by system structural-strength properties. It is well-known fact that initial polymer system consists of chain aggregates which are combined into spatial three-dimensional network. In this case, destruction beginning of initial structure corresponds to pseudoplastic rheopexic state appearance. During all pseudoplastic rheopexic state initial network continues to breakdown right up to clusters formation. Further shear stress increasing leads to system breakdown stopping, equilibrium state establishment, separate clusters moving and pseudoplastic flow appearance. But deformed system may not be in equilibrium state for a long time. Thus, further shear stress increasing leads to system recovery and pseudoplastic thixotropic state appearance.

Hence, it could be concluded that clusters formation determines the surface roughness Ra of corresponding pastes prints. Length of psuodoplastic flow section, in turn, determines the cluster maximum finite size on the surface – Rz parameter. In addition, shear stress value increasing at which pseudoplastic flow starts determines the prints thickness.