Nanocomposites and nanomaterials

Tailoring the ink formulation for advanced inkjet printing of barium titanate films

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This work deals with the selection of the optimal composition of thermal inkjet ink based on BaTiO3 nanopowder and thorough analysis of their physicochemical properties.

In order to study the influence of nature of liquid on the behavior of final suspensions a comparative study of sedimentation characteristics of 5 wt. % $BaTiO_3$ suspensions in various lower aliphatic alcohols has been performed. The study was shown that the best stability was attributed to samples based on ethyl, propyl and butyl alcohols. The selection of optimal dispersant has been performed from a number of nonionic low molecular dispersants that are classified as symmetric aliphatic glycols with terminal hydroxyl groups. Analysis of the sedimentation curves has been shown that the effectiveness of stabilization butanol disperse systems (concentration of solid phase was 5 wt. %) in the presence of saturated linear alkandiol in general is slightly higher than for the corresponding suspensions with using oligoalkylene glycols. This behavior is quite consistent with the Rehbinder's "rule of polarity equalization," according to which the autocoagulation of the particles increases with increasing polarity between the solid and liquid phases.

The final content of the functional components in formulated ceramic suspension has been clarified according to the rheological properties of commercially available ink. The resulting flow curves of investigated specimens suggest that with increasing of added powder-dispersant mass ratio has been observed displacement of flow parameters towards more dilatant values, as well as decreasing duration of the initial region of Newtonian flow. Overall, performed analysis has shown that barium titanate suspension, formulated in n-butanol media and stabilized with the presence of the 20 wt. % of dispersant, had the rheological characteristics identical to industrial design.

Optimized ink has been printed on a flexible polyester substrate with the help of thermal inkjet printer Canon IP2700. Optical profilometry analysis indicated that deposited three-layer dielectric film has total thickness of about 260 nm, whereas the characteristic parameters of surface roughness Ra and Rz are equal to 20.3 nm and 70.6 nm respectively.