

Nanocomposites and nanomaterials

Influence of polymer crystallization on the structural-mechanical properties of pastes based on BaTiO₃ nanopowder

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This paper is about polymer crystallization and structural-mechanical properties of pastes based on BaTiO₃ nanopowder. In our previous work it was established, that the nature of clusters formation depends on the state of polymer macromolecule [1]. Plasticizer addition had a positive influence on the quality of obtained films [2]. But X-ray diffraction method has been shown that addition of plasticizer in the range of 0 - 40 wt. % led to formation of amorphous-crystalline and crystalline pastes. Thus it can be assumed that polymer crystallization determines rheological properties of the pastes. It is well-known fact that industrial pastes should be shear thinned and pseudoplastic-thixotropic under applied shear stresses. Rheological tests showed that among investigated pastes samples with 2.5, 3.75, 8.75, 11.25, 15, 17.5 and 18.75 wt. % of plasticizer were pseudoplastic-thixotropic during all interval of applied shear stresses. The rest pastes successively passed several structural states. These structural features are explained with polymer crystallization. It was found that pseudoplastic-rheopexic – pseudoplastic – pseudoplastic-thixotropic and pseudoplastic – pseudoplastic-thixotropic flow character showed amorphous-crystalline pastes. From the viewpoint of structural-mechanical properties, this means that pastes were long-ordered systems with alternating of crystalline and amorphous regions. Herewith crystallites were in nodes of continuous polymer network. Thus this structure will have some elastic properties and high strength stress due to amorphous phase. In turn, pastes without amorphous phase had rigid structure due to complete polymer crystallization. From the position of screen printing process and obtaining thin elastic layers, the most promising are amorphous-crystalline pastes.

1. S.O. Umerova, I.O. Dulina, A.V. Ragulya Relations between structural-strength properties and cluster formation of highly filled suspensions // 2-nd Int. res. and practice Conf. "NANO-2014", Lviv, Abstract book, P. 398.
2. S.O. Umerova, I.O. Dulina, A.V. Ragulya Formation features of thin bilayer objects «conductor - dielectric» obtained by screen printing method // Int. conf. "NAP-2014". Lviv, Proceedings of Conf. Vol. 1 P. 01NTF04-1 - 6.