Nanostructured surfaces

Structure and properties of epoxy-silica nanocomposites of cationic polymerization

N.G. Leonova[1], S.V. Zhil'tsova[1], R.I. Lyga, V.M. Mikhal'chuk

[1] Donetsk National University. 600-letiya str., 21, Vinnitsa-21021, Ukraine. E-mail: n.leonova@donnu.edu.ua

Epoxy polymers possess high mechanical, electrical, and adhesion properties; hardness and brittleness. The introduction of fillers obtained by the sol-gel method results in the decrease in brittleness and increase in operational characteristics.

The goal of this research was the synthesis of epoxy-silica composites of cationic polymerization with high level of performance properties using in situ sol-gel method for silica particles' synthesis. The starting materials used to produce polymers were tetraethoxysilane (TEOS), diglycidyl ether of dicyclohexylolpropane (EPONEX 1510), the catalysts for cationic polymerization – complexes of boron trifluoride with protonodonors. The epoxy-silica composites were obtained according to the procedure described in [1,2].

It was found that the fractal type structures of primary silica particles with the size of 4-14 nm were formed in the polymer matrix; the size of the nanoparticles raised with the increase of filler content. The number of levels of composites' structural organization depends on the content of the silica component. It was shown that the effect of small additions takes place in the composites with 0.5-1.5 wt. % of silica particles – the high-elastic modulus and the internodal chains concentration increased, while the glass transition temperature decreased. At the concentrations of silica particles higher than 1.5 wt. % the effective network density of the composites lowered – the internodal chains concentration and the glass transition temperature decreased.

It was shown that the received epoxy-silica nanocomposite coatings demonstrate high chemical resistance, maximal impact resistance and provide high adhesion to the aluminum alloy D16. Composite coatings possess high efficiency of corrosion protection of the aluminum alloy D16.

1. *R.I. Lyga, N.G. Leonova, V.M. Mikhal'chuk, A.V. Belyi, V.V. Davidenko*. Composite film coatings based on epoxy-polysiloxane systems of cationic polymerization and their anticorrosion properties // Theoretical and Experimental Chemistry. – 2011. – **47**, N 4. – C. 270–275.

2. *N.G. Leonova, V.M. Mikhal'chuk, Y.P. Mamunya, V.V. Davydenko, M.V. Iurzhenko*. Thermophysical properties of epoxy-polysiloxane composites of cationic polymerization // Polymer Science, Series D. Glues and Sealing Materials. – 2013. – **6**, N 3. – P. 210–217.