

THE COMPUTER SIMULATION OF CONSTANT PHYSICAL FIELDS

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The use of physical fields is quite cheap and safer method. Functional materials with distinct physical and chemical properties can be obtained. The use of mathematical (computer) simulation plays an important role along with experimental research methods. Modeling using digital computers is one of the most powerful means of research. It enables to calculate and simulate experiments at the design stage. Application of modeling allows you to understand how the real object is constructed, its structure, basic properties, laws of development and interaction with the surrounding world, learn to manage the object (or process), to determine the optimal ways of managing it for given goals and criteria, as well as to predict the direct and indirect effects of the implementation of the specified methods and forms of influence on the object. Therefore, this work is devoted to the study of the effect of external permanent magnetic or electric fields on the structure, thermophysical, dielectric properties of epoxy polymers and their composites containing metal oxide and polyaniline.

Samples of composites were formed from epoxy resin ED-20, and triethylenetetramine company "Fluka". Powder cadmium oxide company «Merck Chemicals» and polyaniline were used as fillers. Polyaniline was synthesized by the method. The content of metal oxides was 3 vol. % and polyaniline – 1 vol. %. Samples of composites were subjected to curing with different conditions. The influence of constant magnetic and constant electric fields was $2 \cdot 10^5$ A/m and $1.5 \cdot 10^4$ V/m respectively. All curing processes were done at 293–297 K for 24 hours. Then all polymeric samples were carried out temperature stabilization at 333 ± 2 K for 24 hours.

System studies of structure, thermophysical, thermomechanical and dielectric properties of composites filled with diamagnetic or paramagnetic metal oxides formed under the influence of external constant physical fields were carried out. Patterns of connection between the structure and the physical and mechanical properties of epoxy composites were first established. This makes it possible to purposefully influence external physical fields on the process of solidification of composites in order to obtain materials with a certain complex of functional properties. The introduction of inorganic filler causes the epoxy polymer to dissolution of the structure and reduces the glass transition temperature of the epoxy composite. The estimation of the influence of constant physical fields on the tangent angle of the dielectric losses of the filled composites shows that the orientation effect of constant physical fields increases the free volume of molecular chains of the chemical network of the epoxy polymer.

The ideas of constructing mathematical models and mechanisms of the influence of permanent magnetic and electric fields on epoxy polymers and their composites containing metal oxides and polyaniline have been developed. Based on the results obtained, the method of calculating an electromagnet and a cylindrical capacitor using the software «Elcut» has been improved. The obtained research results can be used as a scientific basis for finding optimal conditions for the formation of the structure of polymer composites filled with dispersed fillers, which will allow obtaining materials with the necessary pre-determined physical, mechanical, electrophysical and thermophysical properties. The obtained materials can be used for the production of thermistors, ion switches of current, elements of microelectronics and supercondensator, as well as coatings for various materials.