

# Composite materials based on vinyl-containing epoxy resins

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**Relevance of the research topic.** Polymer composite materials based on epoxy binders are characterized by high adhesion, slight shrinkage during curing, heat resistance, improved technological capabilities during processing into products and many other valuable properties. This provides a wide range of use of these composites as repair compounds, sealing compounds and for many other purposes. The problem of improving the properties of epoxy resins using various modifiers is relevant and has an important scientific and technical significance. Epoxy oligomers are characterized by significant fragility, which creates obstacles for their use in products operating under difficult stress conditions. In this regard, the creation of binders and composite materials based on epoxy oligomers with increased deformation and strength characteristics is an urgent task.

**The purpose of this thesis** was to develop composite materials based on vinyl-containing epoxy resins with improved deformation and strength characteristics. In accordance with this, research was carried out in the following areas in the dissertation work: the study of the influence of modifiers of various nature on the curing process of epoxy oligomers and the structure of the resulting polymer mesh; the development of composite materials based on modified nanofilled epoxy oligomers with improved properties.

**Scientific novelty** was as follows:

- methods of modification of epoxy oligomers using polyvinyl acetals have been developed, which made it possible to obtain binders with improved characteristics;
- it has been established that during the curing of epoxy oligomers containing polyvinyl acetals, it is possible to control the structure of the resulting products, their physical and mechanical characteristics, as well as accelerate the formation of mesh polymers;
- it was found that the introduction of graphene contributes to the dissipation of mechanical energy and, as a consequence, an increase in the impact strength of the modified epoxy binder;
- it is shown that the nature of changes in the strength properties and glass transition temperatures of the obtained nanocomposites correlates with the geometric shape of carbon nanoparticles, and not with their specific surface area.

**Theoretical and practical significance of the work.** The influence of various vinyl-containing modifiers on the physico-mechanical, thermomechanical properties, morphology of epoxy compositions has been studied. It is shown that the use of compositions based on epoxy oligomers modified with polyvinyl acetals is of fundamental importance for the creation of polymer materials with improved mechanical and thermophysical properties that ensure their wide application. Composite materials based on vinyl-containing epoxy oligomers with nanofillers (graphene, carbon nanotubes, fullerenes) with a wide range of strength and deformation characteristics have been developed. A prepreg technology for producing reinforced epoxy materials with increased cracking resistance, bending strength and impact strength has been developed.

**Defense provisions:**

- development of composite materials with enhanced physical and chemical properties based on epoxy oligomers modified with polyvinyl acetals;
- study of the processes of formation of mesh structures of epoxy oligomers and the influence of polyvinyl acetals on these processes;
- study of the effect of nanomodifiers of various nature on the technological and physico-chemical properties of structured vinyl-containing epoxides;
- technology development for producing nanomodified composites reinforced with aramid fabrics with high impact strength and crack resistance.