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THERMOPHYSICAL AND PHYSICO-MECHANICAL PROPERTIES OF THE ANTIFRICTION EPOXY-POLYSYLOXANE NANOCOMPOSITE

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The results of investigations of thermophysical characteristics, thermomechanical and mechanical properties of epoxy/polysiloxane nanocomposites with different contents of modifying additives in the presence of highly disperse antifriction fillers are presented.

The samples of epoxy polymer were made both without additives and with the addition of highly disperse fillers (polysiloxane particles, PSP, produced by the sol-gel method) in the absence or presence of antifriction fillers such as graphite and molybdenum disulphide (MoS_2) in their compositions.

It was established that the presence of PSP leads to decrease in the cross-link density of the polymer matrix of the composites as it was indicated by the decrease in the glass transition temperature (T_g), increase in the value of high-elastic deformation (L_e), and increase in the effective molecular weight between cross-links (M_c).

It was shown that the introduction of graphite, which is poorly wetted by epoxy resins, into the polymer matrix slightly changes the physical-mechanical characteristics of composite compared to the unmodified epoxy polymer. The structure of the resulting composite is characterized by the presence of macrovoids; this is accompanied by a decrease in T_g and high elasticity temperature T_e and increase in the M_c values.

The samples containing both PSP-modifier and graphite filler have better physical-mechanical properties as a result of the combined influence of the modifier and filler on the formation of a three-dimensional polymer network during the curing process and, as a consequence, on the structure of the composite. Despite the lower T_g and T_e compared to the epoxy polymer, the samples with 1 % and 3 wt % of PSP demonstrate a decrease in the L_e, M_c values and increase in hardness and elastic modulus.

According to the nanoindentation data, a sharp decrease in the creep is observed for the composites containing PSP and graphite. The composite with a content of 3 wt % of PSP and addition of graphite exhibits the lowest value of the elastic energy dissipation at the maximum loading rate; in this case the creep is almost halved. The use of this composite as an antifriction solid lubricant made it possible to raise the contact pressure during cold plastic deformation of titanium alloys to 2.2 GPa.