ZrO_2 NANOPOWDERS AS FILLERS OF EPOXY POLYMERS

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The effect of ZrO_2 nanopowders on the deformation-strength, adhesion, tribological and thermophysical properties of epoxy polymers in a wide range of concentrations has been studied. Zirconium oxide with various heat treatment, differing particle sizes and specific surface area, phase composition and the presence of an alloying additive – Y_2O_3 were used as nanopowders.

The preparation of ZrO_2 nanopowder was carried out by precipitation of hydroxide from a solution of nitric acid salt with an aqueous solution of ammonia. In order to obtain particles of different sizes, zirconium oxide was calcined at 500 and 700°C.

When using ZrO_2 nanopowders as a filler of epoxy polymers, it is possible to achieve an increase in tensile strength, elastic modulus and the work of destruction of the material by more than 100, 80 and 200%, respectively, compared with an unfilled sample.

The dependence of the complex of properties on the calcination temperature of the injected powder is established. Higher values of strength characteristics, modulus of elasticity, fracture work and abrasion resistance when using nanopowders with a calcination temperature of 500°C are associated with a smaller particle size and a larger specific surface area compared to powders obtained at 700°C. The alloying of zirconium dioxide powder with yttrium oxide provides an increase in the modulus of elasticity and compressive strength.

Interesting results were obtained in the study of the effect of the thickness of the samples on their deformation and strength characteristics. It is established that the values of tensile strength and elastic modulus initially increase with increasing sample thickness, reaching a maximum at a sample thickness of ~ 0.4 mm, and then monotonically decrease with increasing sample thickness. At the same time, the thinnest sample has the lowest strength in the entire thickness range, and the thickest has the smallest modulus of elasticity.

The deformation at break at small thicknesses increases almost linearly with increasing sample thickness, reaches a maximum at a sample thickness of 1.5 mm, and then decreases. At the same time, the difference between the maximum and minimum values of tensile strength, modulus of elasticity and deformation at break is 1.45; 4.0 and 1.7 times, respectively. It is revealed that the microhardness index also depends on the geometric dimensions of the sample.