



THERMAL CONDUCTIVITY OF CONVENTIONAL CFRPS AND CNT-NANOCOMPOSITES UNDER ALTERNATING HEAT IMPACT

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ABSTRACT

Carbon fiber reinforced plastics (CFRP) are widely used in civilian and military aircraft and space structures. These materials work at low temperatures and they are undergone periodical heating and cooling. They must withstand a deep cooling and repeated thermal cyclic loading without essential change of their properties.

Thermal cycling leads to essential, sometimes anomalous, changing of thermal properties due to destruction of the material under investigation. Powder and particle fillers improve the resistance of polymer composites to thermal cyclic loading. Nano-fillers improve mechanical and thermal properties at much lower concentration of filler. Using of carbon nanotubes (CNTs) for reinforcement of polymer matrix nanocomposites allows overcoming such disadvantage of polymeric materials as its destruction under alternating heat impact.

The aim of this paper is to investigate the influence of low temperatures and thermal cyclic loading on thermal conductivity of epoxy/carbon nanotube nanocomposites and of epoxy composites reinforced by discrete short phosphorus carbon fibers and compare it to those of CFRP. Some tests on thermal cyclic loading in a range of $77.3\text{K} \div 403\text{K}$ were performed. The sample was placed into liquid nitrogen during 10 minutes and then replaced to air-oven (20 minutes). Amount of thermal cycles was variable. Measurements were carried out in monotonous regime at temperature range from $77,3\text{ K}$ to 423 K . It was shown that multiple thermal cycling results in significant decrease of thermal conductivity of unidirectional CFRPs. Chaotic reinforcement by discrete short CFs slightly enhances cryogenic stability of composites. But CNT-loading greatly increases both thermal conductivity of epoxy composite and its cryogenic stability.

Keywords: thermal conductivity, nanocomposite, carbon nanotube, thermal loading