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DETERMINATION OF THERMOPHYSICAL PROPERTIES OF C/C PLATES WITH CERAMIC NANO-COATING OF DIFFERENT THICKNESS FOR AEROSPACE APPLICATIONS

Abstract

Ensuring reliable protection of structural elements of launch vehicles from heating during flight in the atmosphere has been and remains one of the most important tasks in the design of space technology. One of the possible ways to solve the general problem of improving the energy and mass characteristics of spacecraft can be the creation of a new generation of thermal protection with high specific mass, strength and heat shielding characteristics. The problems of development, creation and application of new materials are urgent and require additional research.

The key factors determining the use of existing and the introduction of new heat-shielding materials are reliable data on the thermophysical characteristics of such materials, which are mainly obtained experimentally.

The main tasks of thermal protection are not only to protect structures, systems and equipment assemblies from overheating at the stages of launching or descent, but also to ensure the necessary thermal regime during operation, especially in manned vehicles. In addition, the materials used for thermal protection should not only have good thermal insulation and heat-shielding properties, but also be as lightweight and technological as possible. In this regard, active development of promising heat-shielding materials with the required strength and mass characteristics is currently underway. High-density composite materials based on a carbon matrix are widely used and very promising for solving a number of heat engineering problems.

In this research, a novel typology of coating based on the application of a commercial ceramic varnish enriched by ceramic nanoparticles onto C/C substrates is presented. Experimental studies of several samples of material made in the form of plates with different coating thicknesses have been carried out. Thermal vacuum studies were carried out on a special thermal test equipminet of the NIO-601 MAI laboratory. The thermal testing provided the solving of the problems to study the heat transfer in the specimens and to estimate the thermal properties of the carbon-carbon materials by means of inverse heat transfer problem.

The obtained thermophysical characteristics can be used to design the thermal protection of new generation.