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Space Structures I - Development and Verification (Space Vehicles and Components) (1)

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MODELING OF ADDITIVE MANUFACTURED HEAT PIPES FOR ADVANCED SMALL SATELLITE  
DESIGN

**Abstract**

Topic of this paper is development of advanced structures for small satellites based on embedded heat pipes manufactured by means of additive technologies. The main idea is to embed high thermally conductive heat pipes into structural elements of a satellite. Obtained result is a structure combining two functions - mechanical protection and thermal control. Potentially, it shall be possible to reduce mass of the thermal subsystem and lessen energy consumption, while providing more uniform distribution of heat along a satellite. Simplification of subsystems may lead to a more reliable satellite. Manufacturing by means of additive technologies allows to vary geometric forms of structural elements in a wide range that may be suitable for different applications.

A number of test samples is manufactured of steel 316L by means of selective laser melting. Further it's planned to use aluminum, so far it's more suitable in terms of mass and heat conductivity. The main values of printed porous structures that were experimentally studied are wettability and permeability. Special testing rigs were developed, results of the tests allowed to define optimal geometric parameters of internal structure providing efficient way of heat exchange.

Procedures of assembly including cleaning, charging and sealing of a prototype heat pipe were also developed and applied to manufactured samples. The samples were tested for reliability of sealing methods and thermal conductivity using thermal vacuum chamber.

Potential impact of the research is enhancement of small satellite industry both in effectiveness of thermal regulation and reduction of costs in terms of decrease of mass and power consumption of a satellite.