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LIGHTLY LOADED REUSABLE THERMAL INTERFACE FOR SPACE APPLICATIONS

Abstract

One focus of several of programs like DARPA's Phoenix program and DLR's iBOSS project is to reduce the costs of space-based systems. These projects aim at the re-design of the established state-of-the-art monolithic bus architecture into an innovative modular and hence serviceable system design.

The modularization of space systems would be a major step towards servicing missions, as it makes on-orbit replacement or upgrading of components feasible. A key issue for this are reusable standardized interfaces to connect the modules and to enable a distribution of power, heat and data through the satellite. This modular approach leads to an extension of spacecraft lifetime, an improvement of satellite performance and reliability and the realization of new mission scenarios.

Simulation has shown that a modular satellite with a thermal interface between neighboring modules can reduce the power consumption of the thermal control system. In addition to this a effective heat transfer between the building blocks helps to reduce thermal stress inside the spacecraft. Investigations have shown, that Thermal interface materials (TIM) has to be used to reduce the contact resistance between two coupled thermal interfaces. However common TIMs cannnot be used without any problems during servicing operation. Gels, other viscous materials and adhesives don't fulfill the requirements of reusability without modification in orbit. Heat conductive pads and foils are reusable, but they need a high clamping force. An approach to overcome this issue would be a forest of vertically aligned Carbon Nanotubes (CNTs), which enables a good thermal contact at a low pressured interface. However existing products provide only is a weak bonding between the CNTs and the surface. Due to this, the CNTs would be easily pulled out of the surface during the de-coupling of two interfaces. To avoid this extraction of CNTs they have to be anchored to the surface or in the body by nesting them in a metal matrix. On account of this a new copper-CNT composite is developed. It can be used as a lightly loaded reusable thermal interface. A couple of samples of this composite with a varying CNT surface density were produced and characterized. The heat transfer coefficient at the face surface and the thermal conductivity of the interface pair of these samples were measured to determine the performance of the system. Also investigations on the reusability have been done. The composite, the production process and first results of the interface performance will be presented.