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OPTIMIZING PHASE CHANGE MATERIAL HEAT SINK GEOMETRIES FOR PASSIVE THERMAL CONTROL OF NANOSATELLITES

Abstract

Current nanosatellite passive thermal control solutions commonly consist of single material heat sinks. These concepts are inexpensive, simple, and easy to implement in nanosatellite geometries. However, phase change material (PCM) heat sinks can be lighter, more volume efficient, and can serve as thermal storage devices for temperature control.

Novel PCM unit geometries are analytically modelled and compared against current nanosatellite solutions. Missions whose orbital trajectories, thermal environment, and hardware power budgets made publically available are tested. Non-nanosatellite missions in which PCM units are employed are also compared against and investigated. The PCM heat sink structure is composed of aluminum, with paraffin wax as the phase changing material. Embedded structures within the paraffin wax offer mass minimization and/or thermal control optimization opportunities (per mission requirements). Research is ongoing into the refinement of the thermal models.