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Solar Cell Packed and Insulator Fused Panels for Efficient Cooling in Cubesat and Satellites

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Abstract : All spacecraft components have a range of allowable temperatures that must be maintained to meet survival and operational requirements during all mission phases. Due to heat absorption, transfer, and emission on one side, the satellite surface presents an asymmetric temperature distribution and causes a change in momentum, which can manifest in spinning and non-spinning satellites in different manners. This problem can cause orbital decays in satellites which, if not corrected, will interfere with its primary objective. The thermal analysis of any satellite requires data from the power budget for each of the components used. This is because each of the components has different power requirements, and they are used at specific times in an orbit. There are three different cases that are run, one is the worst operational hot case, the other one is the worst non-operational cold case, and finally, the operational cold case. Sunlight is a major source of heating that takes place on the satellite. The way in which it affects the spacecraft depends on the distance from the Sun. Any part of a spacecraft or satellite facing the Sun will absorb heat (a net gain), and any facing away will radiate heat (a net loss). We can use the state-of-the-art foldable hybrid insulator/radiator panel. When the panels are opened, that particular side acts as a radiator for dissipating the heat. Here the insulator, in our case, the aerogel, is sandwiched with solar cells and radiator fins (solar cells outside and radiator fins inside). Each insulated side panel can be opened and closed using actuators depending on the telemetry data of the CubeSat. The opening and closing of the panels are dependent on the special code designed for this particular application, where the computer calculates where the Sun is relative to the satellites. According to the data obtained from the sensors, the computer decides which panel to open and by how many degrees. For example, if the panels open 180 degrees, the solar panels will directly face the Sun, in turn increasing the current generator of that particular panel. One example is when one of the corners of the CubeSat is facing or if more than one side is having a considerable amount of sun rays incident on it. Then the code will analyze the optimum opening angle for each panel and adjust accordingly. Another means of cooling is the passive way of cooling. It is the most suitable system for a CubeSat because of its limited power budget constraints, low mass requirements, and less complex design. Other than this fact, it also has other advantages in terms of reliability and cost. One of the passive means is to make the whole chase act as a heat sink. For this, we can make the entire chase out of heat pipes and connect the heat source to this chase with a thermal strap that transfers the heat to the chassis.

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