IAF MATERIALS AND STRUCTURES SYMPOSIUM (C2)
Interactive Presentations - IAF MATERIALS AND STRUCTURES SYMPOSIUM (IP)

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HIGH TEMPERATURE THERMAL MARGIN

Abstract

NASA's Parker Solar Probe (PSP), built by Johns Hopkins University Applied Physics Laboratory and launched in 2018, will fly within 10 solar radii of the sun to provide new data on solar activity. Facing brutal heat, PSP will come as close as 3.83 million miles to the sun which is seven times closer than any spacecraft before. The spacecraft is protected from the Sun's heat by the Thermal Protection System (TPS), which casts a shadow protecting the spacecraft and instruments. The TPS is a 4.5-inch-thick carbon-composite shield that will need to withstand temperatures that reach nearly 2500 F. One major challenge when working with these high temperatures is making sure that there is sufficient thermal margin on the temperature predictions.

The standard thermal margin method was developed for electronics boxes and other components operating at near room temperature and is not applicable for temperatures in the thousands of degree range. The methodology developed for the TPS analysis was to add margin to the thermal model assumptions. At temperature thermal optical properties and thermal conductivity data was collected through a substantial test program. It was important to understand the uncertainty in the test data and ensure that the values used in the thermal model fully bounded the data with the uncertainty. Sensitivity studies were run by varying these properties to understand not only the expected performance but also the worst case performance. Tests were performed at the expected temperatures and at the worst case temperatures to ensure that the TPS would successfully perform at the thermal extremes.