CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)
Catherine M. Colella

Project Number
S1705

Project Title
Spacecraft, Micrometeoroids, and Photons: A Model of Micrometeoroid Impingement to Simulate Thermal Shielding

Abstract

Objectives/Goals
Micrometeoroids pose a significant threat to space exploration. Resistance to micrometeoroid impact is a significant design challenge for spacecraft and spacecraft designers. Long-term exposure can threaten the functionality of spacecraft systems through loss of thermal control. This project investigates the effect of micrometeoroids, using a model, on thin gauge thermally protective metals. Thermal protective capabilities will be modeled and analyzed.

Methods/Materials
Cardboard box (black interior), 500 W halogen lamp, Styrofoam, thermocouple and probe, sand, various thin gauge metals. Heated metal in box using lamp until thermal equilibrium reached. Measured metal temperatures through repeated trials. Calculated photon emission based upon material and estimated emissivity using Stefan-Boltzman relationship. Repeated with sanding of metals to simulate impingement.

Results
Hypothesis of sanded (impinged) surface emanating more heat was shown. Thinner copper had unexpected results, presumably due to some possible invisible oxidation or perhaps more infrared penetration.

Conclusions/Discussion
Found thinner .oo3 in. material would be most successful for thermal shielding. Aluminum appeared to be best material. Results revealed large amounts of heat would emanate from an impinged surface.

Summary Statement
This project investigates the effect of micrometeoroids, using a model, on thin gauge thermally protective metals.

Help Received
Teacher provided suggestions. Parents showed how to use spreadsheets.