Proceedings of CHT-17
ICHMT International Symposium on Advances in Computational Heat Transfer

May 28-June 1, 2017, Napoli, Italy

CHT-17-134

A NEW CONCEPT OF A SOLAR PROBE SHIELDING FROM INTENSE THERMAL RADIATION OF THE SUN

Leonid A. Dombrovsky[*,§], Dmitry L. Reviznikov[**],
Alexei P. Kryukov[***] and Vladimir Yu. Levashov[****]

[*]Joint Institute for High Temperatures, Moscow, Russia
[**]Moscow Aviation Institute (Aerospace University), Russia
[***]Moscow Power Engineering Institute (National Research University), Russia
[****]Institute of Mechanics of Moscow State University, Russia
[§]Correspondence author. Email: ldombr@yandex.ru

ABSTRACT An effect of shielding of an intense solar radiation towards a solar probe with the use of micron-sized particles generated during ablation of a special composite thermal protection material is estimated on the basis of an approximate solution to a conjugate heat transfer problem. The spectral radiative properties of particles are calculated using the Mie theory, and the two-flux model is used for the radiative transfer calculations in the particle cloud. A computational model for the dynamics, heating, and evaporation/sublimation of small particles takes into account the drag force from a rarefied gas moving from the sublimating composite material, the light pressure effect and the radiative heating/cooling of absorbing and scattering particles. A preliminary numerical heat transfer analysis indicates that implementation of silicon carbide or similar particles into a thermal protection and the resulting generation of a rarefied particle cloud can be considered as a promising way to protect the solar probe from the intense thermal irradiation. This shielding effect is expected to be important to decrease the minimum working distance of the space vehicle from the solar photosphere.