RADIATIVE TRANSFER IN A SEMITRANSPARENT HEMISPHERICAL SHELL

Tai-Hsi Fan and Andrei G. Fedorov*
Multiscale Integrated Thermofluidics Lab.
G. W. Woodruff School of Mechanical Engineering
Georgia Institute of Technology, Atlanta, Georgia 30332, USA

ABSTRACT. Radiative transfer in a semitransparent hemispherical shell placed on an opaque surface is simple yet realistic representation of the heating process encountered in various materials processing applications ranging from metallurgical slag foaming to batch foams in glass melting to hollow bead fabrication. The objective of this paper is to develop fundamental understanding and predictive models for the apparent radiative properties of a hemispherical shell exposed to incident collimated radiation. Both analytical and numerical results are obtained and compared against each other for the purpose of validation of an analytical model. The study provides fundamental information on radiative transfer in a semitransparent hemispherical shell as well as presents an effective numerical algorithm to calculate the local intensity field and thus the local volumetric heating in the shell.