RAD-13-SO3

LIGHT TRANSPORT ANALYSIS OF SMART WINDOWS FOR SOLAR ENERGY HARVESTING

Onur Taylan, Thomas E. Murphy, Halil Berberoglu
Mechanical Engineering Department
The University of Texas at Austin
204 E. Dean Keeton St., Austin, TX 78712 USA

ABSTRACT. This paper presents a numerical study, analyzing the transport of light within a novel window concept that uses nanoparticles to guide the incident light to its edges covered with solar cells for generating electrical power. For illustrative purposes, silica coated silver nanoparticles of core radius 50 nm are considered in acrylic windows. The radiation characteristics of the nanoparticles are determined using the Mie theory for coated spheres and analyzed for the effects of the coating thickness as well as the metal core size over the wavelengths from 300 nm to 1100 nm. A three dimensional Monte Carlo model has been created to determine the concentration factor, the effective transmittance, absorptance, and reflectance of the window as functions of particle number density and different window dimensions. Both collimated and diffuse components of solar radiation were taken into account at 550 nm and 900 nm. The results indicated that a critical particle number density existed for maximizing the concentration factor as well as defining the borderline between a light transport regime dominated by window transmittance and a regime dominated by window absorptance.