Proceedings of the 6th International Conference on Combustion Science and Processes (CSP'21)
London, England – March, 2020
DOI:

Spectral Tuning of Solar Irradiation for Energy Collection and Illumination and Conservation in Radiation Scattering Angle

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In recent decade nanofluids have been intensively investigated for enhancing solar energy collection. We recently proposed a new idea and louver device for simultaneous solar energy harvesting and daylighting. Water is nearly transparent to visible (VIS) light but highly absorbing of ultraviolet (UV) and infrared (IR). Thus, water-based nanofluids could be employed to spectrally tune the solar irradiation to realize the dual-purpose: illumination and energy harvesting. In this talk, we will investigate the spectral absorption and scattering efficiencies of some nanoparticles (NPs) commonly used in solar energy research. The effects of NP size and concentration are scrutinized. Results show that a louver filled with dilute 0.00004 vol% Ni-water nanofluid with particle diameter of 80 nm under AM1.5 model can transmit 46.5% solar VIS for daylighting and harvest 65.7% of the total solar energy. The second part of this keynote talk will review our discovery and solutions on the conservation of asymmetry factor in addition to the conservation of scattered energy for computing radiation transfer equation. Simultaneous conservation of both the quantities reserves the zeroth- and first-order of Mie scattering phase function and clarifies the discrepancies among different numerical methods existed in radiation field for long time.