Director de tesis: Dr. Manuel Ignacio Peña Cruz

Sinodales:

Dr. Luis Armando Díaz Torres
(Sinodal Interno, Secretario)

Dr. Camilo Alberto Arancibia Bulnes
(Sinodal Externo – IER UNAM, Vocal)

Dr. Manuel Ignacio Peña Cruz
(Director de Tesis, Presidente del Jurado)

Tesis: "OPTICAL THERMAL CHARACTERIZATION OF A HIGH FLUX SOLAR SIMULATOR FOR THE DEVELOPMENT OF SPECTRAL ABSORPTION APPLICATIONS"

Resumen:

Solar technologies, such as concentrating solar power (CSP) systems, are one of the most promising technologies for covering the future global energy demand, achieving a low-carbon economy and mitigating environmental problems (greenhouse effect). Typically, outdoor solar facilities are implemented for evaluating solar receivers and prototypes, but the intermittent nature of solar radiation and weather constrains are the main challenges in offering stable testing environments. Solar simulators have been identified as key facilities for carrying out high-quality indoor assessments under a controlled lab-scale environment. This PhD thesis is aimed to the optical design and characterization of a high flux solar simulator (HFSS) for researching solarthermal and thermochemical processes. To do so, a 17.5 kWe HFSS was developed along with a calorimetric test bench for the assessment of solar-thermal materials. The design of the 7 xenon lamps based solar simulator was numerically analyzed through the Monte Carlo ray-tracing method and characterized with the indirect flux mapping technique, an optical technique that involves the use of a high resolution camera and a diffusely reflective flat target plate. Characterization results showed a total peak flux of up to 1327 ± 58 kW/m2 having an intercepted radiative power of 5.11 ± 0.22 kW over a flux spot distribution of 120 mm in diameter, and conversion efficiency of 33%. Regarding the calorimetric test bench, its design was based on a flat-plate calorimeter which provides the versatility to replace test samples as interchangeable cartridges. By coupling the test bench with the HFSS, solar-thermal assessments of 4 different commercial solar absorber coatings and a new soot of forest biomass based coating were experimentally evaluated and compared under the same operating conditions. The presented approach for evaluating commercial and new solar-thermal materials provides critical information about their optical-thermal capabilities. Accordingly, the flux acceptance of suitable materials for their usage in solar-based industrial process heating can be effectively determined, and further progress in the improvement of solar-thermal technologies can be accomplished.