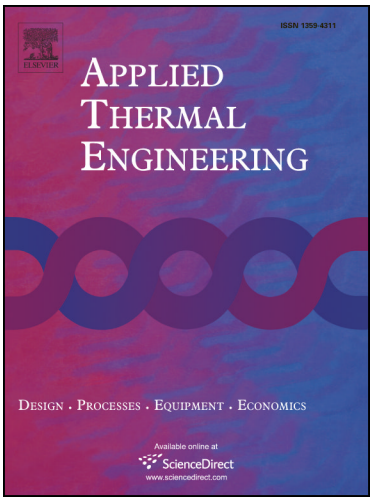

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Design and characterization of a high-flux non-coaxial concentrating solar simulator

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Abstract

To improve the spatial uniformity of the concentrating solar simulators, a concept of non-coaxial deflection angle was introduced to the typical ellipsoidal reflectors. Based on this idea, a new-type 42 kW_e high-flux non-coaxial concentrating solar simulator was designed and built. The Monte Carlo ray-tracing technique was applied to optimize the value of the non-coaxial deflection angle and simulate the flux distribution of this new-type solar simulator. A flux mapping system based on the indirect method was used to characterize the solar simulator optically. The relative deviation for the measured and the simulated results of this new-type solar simulator, as well as the simulated results of a conventional concentrating solar simulator, were compared and analyzed. The results show that the spatial nonuniformity of this new-type solar simulator over a circular target of 50 mm in diameter, improved to 7.2% from 40.3% of a conventional one. This non-coaxial concentrating solar simulator is considered very suitable for high-temperature solar thermal, thermochemical and high-concentration photovoltaic applications, especially where there are strict requirements for spatial uniformity.

Keywords: non-coaxial; concentrating solar simulator; Monte Carlo ray-tracing; flux mapping