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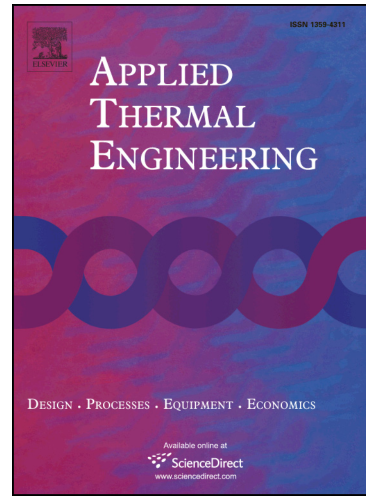

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A Review of High-Temperature Particle Receivers for Concentrating Solar Power

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Abstract

High-temperature particle receivers can increase the operating temperature of concentrating solar power (CSP) systems, improving solar-to-electric efficiency and lowering costs. Unlike conventional receivers that employ fluid flowing through tubular receivers, falling particle receivers use solid particles that are heated directly as they fall through a beam of concentrated sunlight, with particle temperatures capable of reaching 1000 °C and higher. Once heated, the hot particles may be stored and used to generate electricity in a power cycle or to create process heat. Because the solar energy is directly absorbed by the particles, the flux and temperature limitations associated with tubular central receivers are mitigated, allowing for greater concentration ratios and thermal efficiencies. Alternative particle receiver designs include free-falling, obstructed flow, centrifugal, flow in tubes with or without fluidization, multi-pass recirculation, north- or south-facing, and face-down configurations. This paper provides a review of these alternative designs, along with benefits, technical challenges, and costs.

1. Introduction

Higher efficiency power cycles are being pursued to reduce the levelized cost of energy from concentrating solar power tower technologies [1]. These cycles, which include combined