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RADIATIVE TRANSFER IN HIGH-TEMPERATURE MULTI-PHASE SOLAR THERMOCHEMICAL REACTORS

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ABSTRACT

Two thermochemical routes for solar hydrogen production are examined: 1) H_2O-splitting cycle via metal oxide redox reactions, and 2) decarbonization of fossil fuels via thermal cracking, gasification, and reforming reactions. Chemical reactor designs and performances are presented for the endothermic processes, using concentrated solar radiation as the energy source of high-temperature process heat. These reactors feature efficient heat transfer by direct high-flux irradiation of the gas-particle chemical reacting systems. Modeling tools are applied for understanding and predicting the fundamental characteristics of this interaction. The Monte Carlo and band-approximation radiosity methods are employed for the analysis of the radiative exchange within an absorbing-emitting-scattering media undergoing a chemical transformation. Such an analysis enables the design of the solar chemical reactor configuration for absorbing efficiently the incoming radiative power flux and for matching the rate of radiation heat transfer to the reaction kinetics.

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