Simulation of transport phenomena in a photo-electrochemical reactor for solar hydrogen production

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Abstract:

A numerical simulation of transport phenomena in the photo-electrochemical (PEC) reactor is performed. The transport phenomena equations include the Navier-Stokes, the respective energy equation for electrolyte, and the radiative transfer equation (RTE). Two different designs, design A, and design B of photo-electrochemical reactors are suggested. The hydrogen production rate and solar-to-hydrogen efficiency are estimated for each design at different solar incident flux ranged from 500 to 2000 W/m2 in increments of 500 W/m2. Results have shown that the solar-to-hydrogen efficiency increases as solar flux increases for both designs. Its predicted values could reach 12.8% for design A, and 13.1% for design B. Moreover, by increasing the solar incident flux, the hydrogen volume production rate is increased as well. It is found to be 79 L/m2.h for design A, and 85.4 L/m2.h for design B. Comparison between currently predicted results and previous data indicates an enhancement of solar-to-hydrogen efficiency and hydrogen production that can be achieved with the suggested design

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