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Mathematical modelling of a photoelectrochemical anion exchange membrane electrolyser for sustainable hydrogen production

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Abstract

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Abstract

Solar hydrogen production using a photoelectrochemical anion exchange membrane reactor is vital to reduce our dependence on fossil fuels. Anion exchange membranes use electrocatalysts based on low-cost earth metals. This paper provides a mathematical model to understand the influence of operating parameters on a photoelectrochemical anion exchange membrane reactor using Engineering Equation Solver (EES). It is used to estimate the performance of a reactor with hydrogen mass flow rate, energy and exergy efficiency. The results indicate the highest hydrogen production of 75.92 μg/s at a solar irradiation flux of 600 W/m^2. Overall energy efficiency decreases as the photocathode illumination area increases while the mass flow rate of hydrogen increases. Moreover, with the change in illuminated area from 0.04 to 0.08 m^2, the overall efficiency decreases from 12.32% to 10.76%. Mathematical modelling indicates that the mass flow rate of hydrogen is directly proportional to the solar irradiation flux, illuminated area and quantum efficiency. © 2024 Hydrogen Energy Publications LLC

Author keywords

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