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Optimized solar spectral splitting for efficient thermo-photovoltaic hydrogen production

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Solar Hydrogen is potentially one of the carbon-free-source of energy that could replace most of the exhausting and pollution-associated fossil fuels. Incorporating hybrid thermo-photovoltaic system to the water electrolysis by converting the sunlight into managed heat and electricity is useful to promote such technology into broad application. Optimizing the sunlight splitting by spectral selectivity of the solar spectrum such that certain spectrum band is utilized to produce electricity by the photovoltaic conversion which drives the water electrolysis, whereas, the remaining sunlight is used for heating water to produce steam, which requires less electrolysis electricity because of the gained sensible and latent heats, could lead to new boundaries of efficient sunlight to Hydrogen conversion. In this publication, it we report that an optimized spectral splitting for a hybrid thermo-photovoltaic water electrolysis could theoretically convert 82 % of the solar energy into Hydrogen fuel by employing 90% efficient solar-thermal convertor. The significance of our work compared with the previous attempts that have handled the optimal photon management in the hybrid thermo-photovoltaic system is that not only it predicts higher solar-to-hydrogen conversion efficiency, but also it depends on a more realistic optimization model since the major losses that associate the photovoltaic conversion like the thermalization process and the limiting fill factor of the PV cell were accounted. Therefore, the methodology and the results of this work are could be a useful recipe for an effective solar-hydrogen production, which could boost the possibilities to make it thrive as a reliable carbon-free-source of energy.

Biography

Rabi Ibrahim Rabady was born in Irbid, Jordan in 1971. He received the B.Sc. degree from Jordan University of Science and Technology, Irbid, Jordan, in 1994 and M.S. and Ph.D. degrees from Wayne State University, Detroit, Michigan in 1998 and 2003, respectively, all in electrical engineering. From 2004 to 2005 he was a Full Time Lecturer at Yarmouk University, Irbid, Jordan. Currently, he is with the Electrical Engineering Department at Jordan University of Science and Technology, Irbid, Jordan since 2005, and now serving as Associate Professor there. His research interests are in optical filtering, nonlinear optics, optical thin films and waveguides, solar and hydrogen energy technologies and applications, solar concentrators, lens design, and optimization methods.

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