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Solar PV/T integrated reversible solid oxide fuel cell system for power generation and storage

S Ghosh, A Ghosh and A K Mishra
Indian Institute of Engineering Science and Technology, India

In this paper, a novel power generation cum storage system employing reversible solid oxide fuel cell (RSOFC) has been proposed. The RSOFC is integrated with solar PV/T system that also includes parabolic trough solar collectors (PTSC). The RSOFC unit operates in steam electrolyser mode (during day time) and in fuel cell mode (during night time). The electrochemical model is developed for a proton conducting reversible solid oxide fuel cell (RSOFC-H) and its performance analysis is done both in fuel cell mode and electrolysis mode of operation. A comparative performance analysis has also been done between conventional oxide ion conducting reversible SOFC (RSOFC-O) and proton conducting RSOFC-H for suitably chosen range of current density to cover both the cells' common operating range (500 A/m^2 to 5000A/m^2). Computational simulation model for the integrated plant has been developed and the simulated performance analyzed both using energy and exergy approaches. The results suggest that the solar-integrated system can yield an overall solar-to-gas conversion efficiency of about 18% in electrolysis mode while in fuel cell mode the conversion efficiency (gas-to-power) would be about 40%.

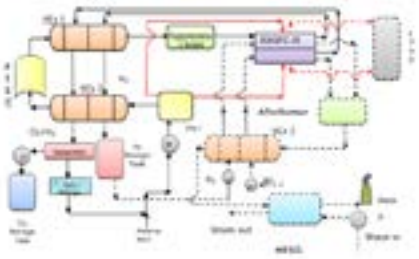

Figure: Solar integrated RSOFC power generation cum storage system

Recent Publications

1. Saetova N S, Krainova D A, Kuzmin, A V, Raskovalov A A, Zharkinova S T, Porotnikova N M and Ghosh S (2019) Alumina–silica glass–ceramic sealants for tubular solid oxide fuel cells. Journal of Materials Science 54(6):4532-4545.
2. Huang N, Zhao P, Ghosh S and Fedyukhin A (2019) Co-hydrothermal carbonization of polyvinyl chloride and moist biomass to remove chlorine and inorganics for clean fuel production. Applied Energy 240:882-892.
3. Roy D, Samanta S and Ghosh S (2019) Techno-economic and environmental analyses of a biomass based system employing solid oxide fuel cell, externally fired gas turbine and organic Rankine cycle. Journal of Cleaner Production.
4. Roy D, Samanta S and Ghosh S (2019) Energetic, exergetic and economic (3E) investigation of biomass gasification-based power generation system employing molten carbonate fuel cell (MCFC), indirectly heated air turbine and an organic Rankine cycle. Journal of the Brazilian Society of Mechanical Sciences and Engineering 41:112.

Biography

S Ghosh is an Associate Professor in the Department of Mechanical Engineering, Indian Institute of Engineering Science and Technology, Shibpur. He received his Bachelor of Engineering (Mechanical) from University of North Bengal, India, in 1991, Master of Engineering (Heat Power) from Calcutta University, in 1993 and PhD from Jadavpur University in 2005. Besides having a two-decade long teaching and research experience, his career includes industrial work experience at ABB ABL, Durgapur, India (later taken over by Alstom Power). His areas of research include Clean Coal Technology, Renewable Energy Technologies like Fuel Cells, Biomass Gasification and Greenhouse Technology. He is closely associated with a few renewable energy research groups in Europe, USA and Canada and he has served as Guest Scientist at Paul Scherrer Institute (PSI), Switzerland (during 2006 and 2007), where his focus of work was development and technology demonstration of biomass gasification integrated fuel cell (SOFC) system.

sudipghosh.becollege@gmail.com

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