The Fourth Annual Research Symposium (ARS-2017)
Faculty of Engineering, University of Ruhuna, Hapugala, Galle.

ARS 2017/ M/17

Feasibility Study on Efficiency Improvement in Photovoltaic Cell by Heat Pipe Surface Cooling Methods

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Solar energy is an abundant renewable energy source and then worldwide attention has paid to use this source for the electricity generation. The photovoltaic (PV) effect is most widely utilized as direct conversion of sunlight into electricity in Photovoltaic Cells (Solar Panels). When solar panels expose to the sunlight, the temperature of the panels increases with the time and the efficiency of electricity generation decreases. At present, many methods are employed to maintain the solar panel temperature at a lower value; however, they are not effective. In the present study, gravity assisted heat pipes (Thermosyphon) were employed to reduce the cell surface temperature as heat pipes are known to be two-phase heat transfer devices with extremely high effective thermal conductivity. An appropriate refrigerant for the heat pipes was selected considering the average high temperature of the solar panel and the ambient temperature. An array of heat pipes was fabricated and fixed to the bottom surface of the solar panel. The dimensions of the heat pipes used for the array are length 1 m and diameter 16 mm. For a single heat pipe with the same dimensions, a performance test was conducted with 60 W power input and the test results showed that the overall heat transfer coefficient at the condenser section of the heat pipe was 104937.33 W/m^2K. With the array of the heat pipes fixed to the solar panel an outdoor tests were carried out to find feasibility of maintaining a constant temperature of the panel for efficient electricity generation.

Keywords: photovoltic cell, heat pipe, thermosyphon, electricity generation, efficiency