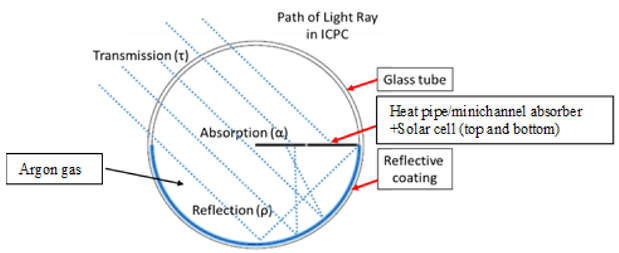
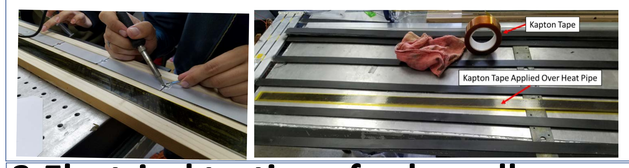
Combined Solar Power and Heat for Electricity, Hot Water, and Space Heating

Ali Hassanzadeh, Bennett Widyolar, Jordyn Brinkley, Sai Phani Kiran, Lun Jiang, Roland Winston

1. Prototyping

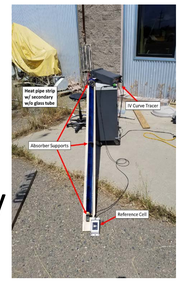
This project's goal is to provide total heat and electricity required for a household using PV/T collector. As the major cost of PV is the installation cost, combing the solar heat and electricity in a single collector doubles the collector value without increasing its capital cost significantly. As the poster presented in UC Solar symposium 2017, thermal-optical simulation in COMSOL Multiphysics indicated that horizontal absorber has better optical efficiency and less heat loss. Therefore, prototyping the 5 collectors with horizontal heat pipe absorber and 5 collector with minichannel absorber has been done to compare the thermal and optical performance under real-condition. The SunPower solar cells cut, soldered together and taped on the both side of heat pipe and minichannel absorber to measure the electrical efficiency.

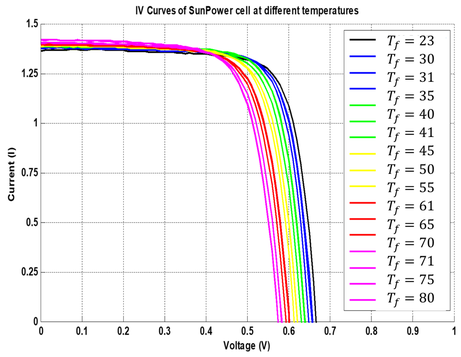


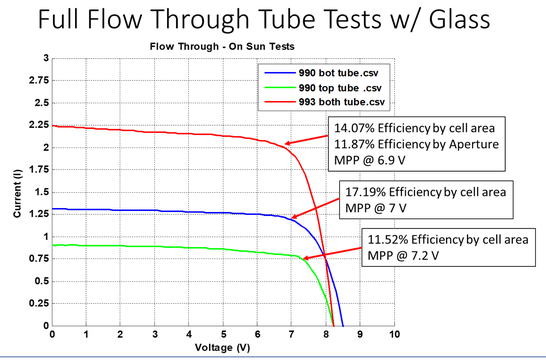


3.Electrical testing of solar cells

To measure electrical efficiency of the solar cell after cutting and soldering, I-V curve tracer has been used for a single collector to measure top and bottom solar cell and plotted(bottom right figure), also electrical efficiency Based on water temperature is plotted(bottom left).



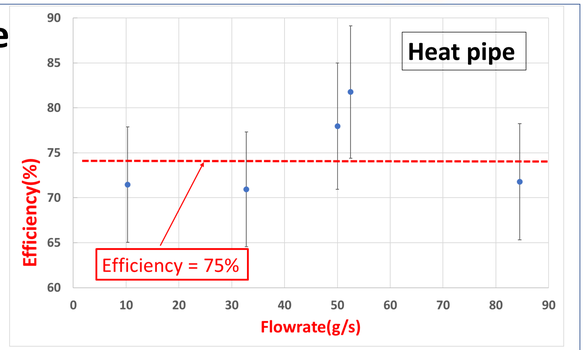


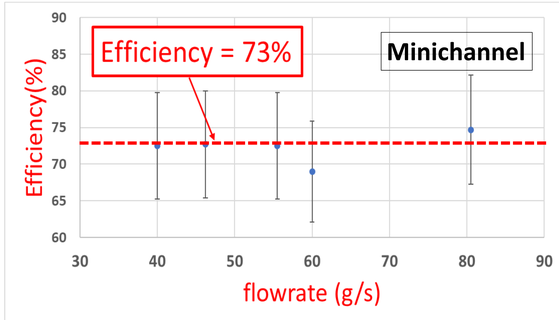


2. Thermal testing of minichannel/heatpipe

In order to predict thermal performance of the collector, 5 collectors with Heat pipe and 5 collectors with minichannel are tested without solar cell.

The results shows optical efficiency of the solar array with minichannel absorber is about 73% at the ambient temperature. Also the optical efficiency of solar array with 5 heat pipe absorber is about 75% which make both absorbers Economically viable for mass manufacturing.

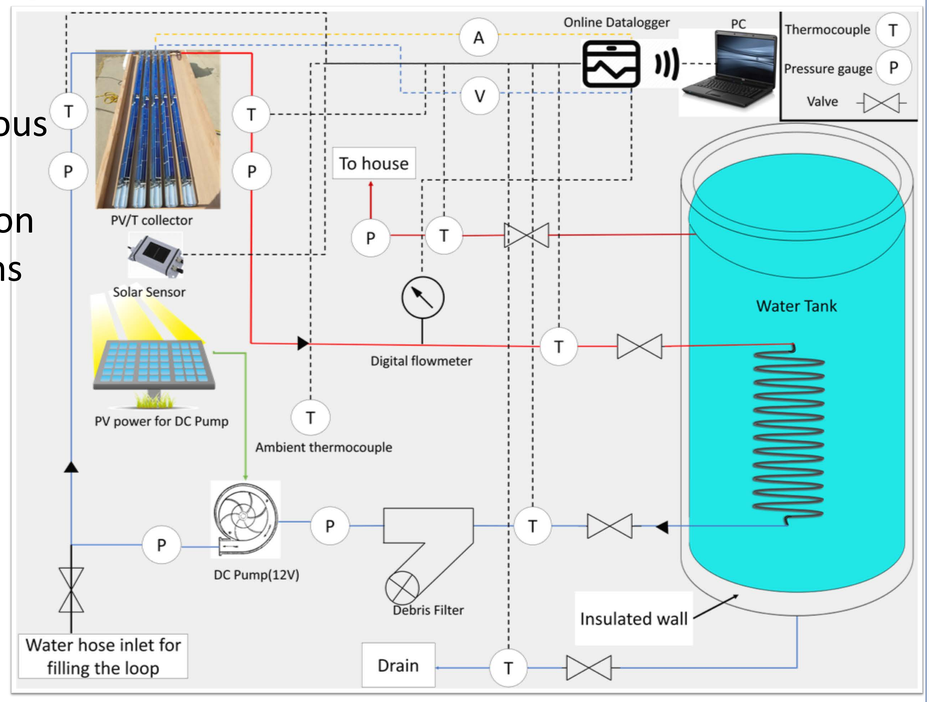




4- Real-condition testing of the PV/T collectors for a month

In order to simulate roof-top condition for a month, an autonomous closed-loop system designed which turns on at the sunrise and turns off in the sunset .

10 collectors are connected to the water Tank in a closed-loop System. temperatures, Voltage and current Will be recorded as it is Shown in the figure.



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