Microchannel Receiver Development

Oregon State University

Award Number: EE0005801: May 15, 13 | Drost

PROJECT OBJECTIVES

Goal: Microchannel heat exchangers can attain very high rates of heat transfer. This will allow an increase in the maximum receiver flux by a factor of 5 to 10 which will result in a reduction in the size of the receiver by a similar amount which in turn leads to a reduction in thermal losses from the receiver and possibly receiver cost.

Innovation: This use of microchannel geometries for heat transfer can attain allowable receiver fluxes of 100 W/cm^2 for supercritical CO_2 receivers and 400 W/cm^2 for molten salt receivers. This should be compared to a maximum allowable flux of 30 to 100 [1]W/cm^2 for current receiver technology.

[1]Romero, M., Buck, R., and Pacheco, J. E., 2002

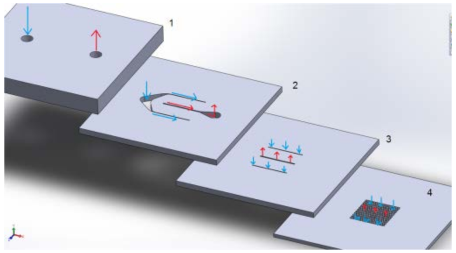
Milestones: None during reporting period.

APPROACH

- Use simulation to develop designs of both a supercritical CO_2 receiver and a molten salt receiver capable of achieving the performance includes in the project objectives.
- Based on simulation results use microlamination to assemble laboratory test articles for supercritcial CO_2 and molten salt.
- Assemble a flux concentrator capable of achieving 400 W/cm^2 incident flux and assemble test loops for supercritical CO_2 and molten salt
- Complete a laboratory demonstrate the ability of the test articles to meet the required performance.
- Based on laboratory results, assemble a supercritical CO_2 test article and test using the PNNL solar dish concentrator.
- Use simulation to design a microscale adaptive flow control system
- Complete a laboratory demonstration of a single and multiple channel adaptive flow control device.

KEY RESULTS AND OUTCOMES

- Based on our structural analysis it appears that the use of refractory metals will allow a receiver design that can operate with 100 Bar CO_2 at 600 C. We have identified vendors and fabrication options for the CO_2 test article.
- We have completed the design and assembly of the flux concentrator and are assembling the CO2 test loop, molten salt test loop and an apparatus for testing microchannel receivers at pressure and temperature.



Design of Supercritical CO_2 test article

NEXT MILESTONES

- No goals from the SOPO will be completed in the next reporting period.
- Task 1 – Key risk is that no design will meet the projects objectives, the use of arrays of pins appears to meet all of our performance goals.
- Task 2 – The key risks are delamination due to the high pressure of supercritical CO_2 and thermal stresses. The use of refractory metals in place of stainless steel appear to result in a design that can meet our performance goals and fabrication options have been identified.
- Task 3 – The key risk is in the performance of the flux concentrator, we are minimizing that risk by using approaches developed and documented by others.
- Task 4 – Risks will be minimized by using simulation to identify attractive designs before initiating experimental investigations.