SAND2014-3395P

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Sandia National Laboratories

Heat Transfer Technologies in Concentrated Solar Power

Wick Structures for high performance heat pipes

Durable wick heat transfer structures with 3-dimensionally tuned pores and backbone scaffolds enable efficient Dish Sterling systems for utility scale CSP.

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Problem Statement:

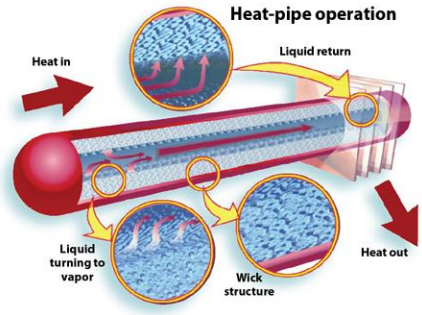
Sandia has demonstrated Dish Sterling Systems with world-record solar-to-grid energy conversion efficiency with the potential to make Concentrated Solar Power cost competitive with conventional grid energy. However, implementation at the utility scale will require the development of energy storage. Sandia has a promising storage and transport concept using liquid metal heat pipes. However, the current metal "felts" used as a wick within these heat pipes cannot handle the high temperatures without losing integrity, and the rate of flow of molten sodium is too slow. A durable wick structure for high temperature sodium heat pipes is needed that will double the thermal throughput capability of commercially available wicks.

Approach:

A high performance wick must be highly permeable and structured with a pore radius distribution from 5 to 80 microns. This project proposes to model, develop, and demonstrate wick structures that maintain high performance while enhancing structural robustness through the growth of the wick structure rather than through assembling a structure (as in pressing fibers together to form a felt). The proposed advanced microfabrication approaches include colloidal crystal templating, solution grown ceramic structures as wicks or backbones for wicks, and multi-scale crystalline growth structures.

Impact:

Success will present a key enabling technology for latent storage on Dish Stirling systems lowering the cost of solar energy to grid-competitive levels. The materials and functional understanding will greatly advance the position of Dish Stirling and therefore solar energy in the US energy portfolio. Spinoff applications include re-entry vehicle cooling, furnace liners, and nuclear power applications. Low temperature uses could include electronics cooling.



U.S. DEPARTMENT OF ENERGY
NNSA National Nuclear Security Administration

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