Concentrated Solar Thermoelectric Power

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PROJECT OBJECTIVES

Goal: To develop a 10% efficient solar energy conversion system based on thermoelectric materials. Unlike photovoltaics, thermoelectrics can convert the heat from the entire solar spectrum. Since this is a thermal system, it can be coupled with thermal storage to enable 24-hour power generation.

Innovation: The highest published solar thermoelectric efficiency is 4.6%.[1] Our modeling[2] suggests that with optical concentration, we can double this efficiency.

Milestones: This quarter (the first of the project) we aimed to begin initial development and testing of thermoelectric contacts, selective surfaces, and emittance-reducing optical systems.

[1]D. Kraemer, et al., *Nature Materials*, **10**, 532 (2011).
[2]K. McEnaney et al., *Journal of Applied Physics*, **110**, 074502 (2011).

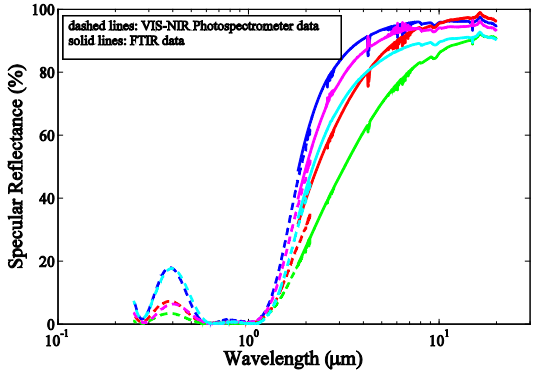
APPROACH

- We are using various modeling approaches[2,3] to simulate our solar thermoelectric generators.
- We are fabricating wavelength-selective surfaces via sputtering.
- We are testing selective surface absorption and emission using spectroscopy (FTIR and VIS-NIR) and a custom-built test setup.
- We are investigating various compounds to create contacts and diffusion barriers for thermoelectric materials.
- We are investigating electroplating techniques for developing very low contact resistance interfaces.

[3]D. Kraemer et al., *Solar Energy*, **86**, 1338 (2012).

KEY RESULTS AND OUTCOMES

- Initial selective surfaces show good wavelength selectivity (low reflectance in solar spectrum, jumping to high reflectance at longer wavelengths.



NEXT MILESTONES

- Develop and test improved selective surfaces, using spectroscopy and custom-built test setup.
- Test single-stage thermoelectric generators with new contact materials.
- Characterize solar simulator as input to complete the optical system design.
- Complete model for segmented thermoelectric generator.