07108

Mitigation of Fabrication Challenges in High Pressure/Temperature Micro-pin Solar Receivers

1. Impact

Submillimeter flow features can enable Gen3CSP receiver goals of efficient, high temperature/high pressure operation for multiple heat transfer fluids. This project retires risks associated with receivers with an expected efficiency > 90% and cost < $150/kWh$_{th}$.

2. Project Goal

Design, build and test a micro-pin based solar receiver heating supercritical carbon dioxide to >700°C in a design capable of efficiency > 90%.

3. Method(s)

Use separate effects simulation/experiments to specify design, materials and fabrication methods. Conduct FMEA and developed mitigation strategies for fabrication of prototypes. Integrate design and fabrication method improvements in on-sun prototype test article.

4. Outcome(s)

Fabrication challenges identified and mitigated via a systematic failure mode effects analysis approach. A 15 cm × 15 cm protype device fabricated capable of withstanding 414 bar of pressure and high pressure cycling at 720°C.

5. Conclusion/Risks

Modular, micro-pin receivers improve heat transfer and reduce material use. Identified fabrication challenges (diffusion bonding, brazing, welding) with high nickel alloys were retired. On-sun testing to be conducted in August 2021.

6. Team

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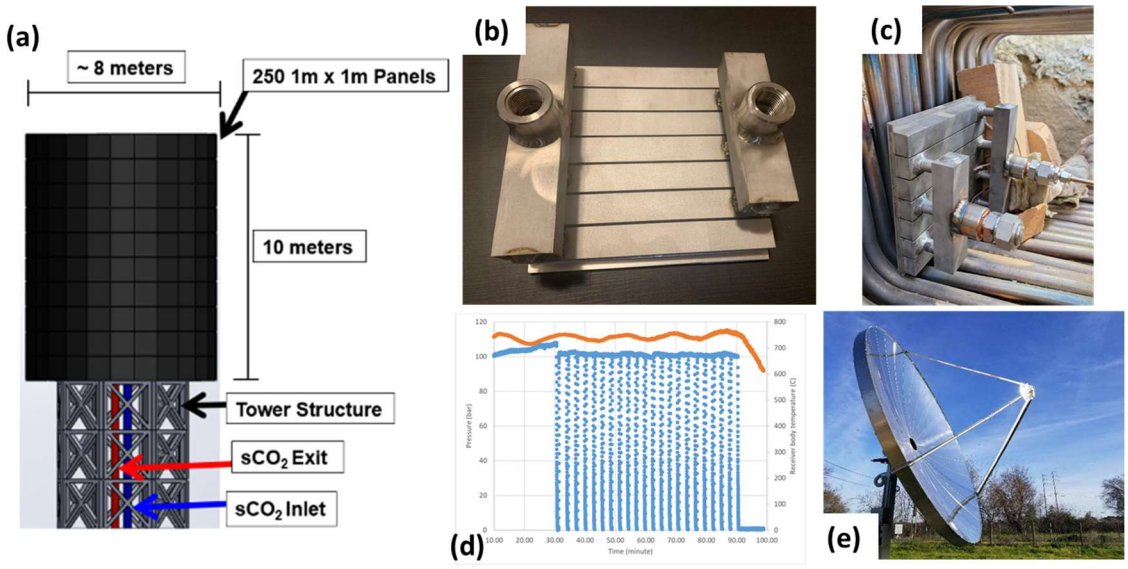

Figure 1. (a) rendering of multi-modular receiver (b) prototype receiver (c) temperature/pressure cycling facility (d) results of high temperature pressure cycling test, and (e) dish for on-sun testing