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Dish-concentrated solar receivers operate in the 500–800 °C hot-side range, well above the 250 °C ceiling of commercial bismuth-telluride (BiTe) thermoelectric modules and inside MicroPower's PbTe / TAGS platform envelope. This paper sets out the architectural fit, the module-level performance the platform delivers today, and where dish-CSP sits in the MicroPower portfolio.

1 · The CSP opportunity

Concentrated Solar Power (CSP) at residential and commercial scale uses parabolic-dish concentrators to focus solar flux onto a receiver. Receiver hot-side temperatures depend on concentration ratio and receiver geometry; for typical dish systems they sit in the 500–800 °C range. That window is well above the 250 °C ceiling of commercial BiTe TEG modules and directly inside MicroPower's 300–1,000 °C hot-side envelope.

2 · Why TEG, not Stirling or ORC

Dish-Stirling has been the historical small-scale CSP conversion technology. The engine is complex, includes rotating machinery, and has been hard to commercialise at competitive price points. ORC needs working fluid, pumps, and a turbine. A solid-state thermoelectric conversion stage at the receiver is mechanically simpler, has no working fluid, and operates at the same temperatures the dish naturally produces.

MicroPower's PbTe / TAGS chip platform operates across the 300–1,000 °C hot-side design range that a dish receiver supplies; continuous operation is lab- and field-proven 440–550 °C. The chip's high-temperature contact and thermal-interface structures were informed by an early MicroPower collaboration with the U.S. Army Research Laboratory and have been substantially evolved internally since. The 14% module conversion efficiency at 550 °C is extrapolated from the U.S. Army Research Laboratory's evaluation of MicroPower's standard modules. NREL subsequently confirmed independently that production modules met datasheet specification.

3 · Efficiency picture

Production-spec module conversion efficiency on the current PbTe / TAGS platform is 14% at 550 °C (extrapolated from ARL's evaluation of MicroPower's standard modules; independently confirmed by NREL against datasheet). Installed-system efficiency after heat-exchanger losses, thermal interfaces, and cold-side gradient is typically 6–10% under realistic field conditions. Power density at the chip level is 11 W/cm^2 on the production platform.

MicroPower's separately patented MBE-grown energy-sorting barrier-layer architecture multiplies chip-level power density 1.5–1.8× on top of the baseline platform; that figure is from internal MicroPower lab measurement on the prototype barrier layer and is not in production-spec modules today. Reintroducing the barrier layer into production is on the post-funding roadmap and would shift the chip-level performance envelope further into dish-CSP-relevant territory.

4 · System-level engineering

Two engineering drivers dominate at the dish receiver. First, cold-side maintenance: receiver geometry constrains the available heat-rejection surface, and cold-side temperature directly sets module output for any given hot-side temperature. Second, hot-side optical and thermal contact: the receiver-to-module interface determines how much of the concentrated flux actually reaches the chip stack.

Receiver-integrated TEG geometry differs from the flat-plate PowerBlock or pipe-wrap PowerRing form factors used in industrial waste heat. A dish-receiver-integrated module is purpose-engineered to the optical and thermal envelope of a specific dish-integrator's hardware and is therefore best developed as a co-engineering project with that partner.

Solar concentration ratio — derivation. The 11 W/cm^2 electrical power density implies a thermal supply of 110 W/cm^2 at 10% system efficiency. At standard terrestrial solar noon (1,000 W/m^2 = 0.1 W/cm^2), this requires a solar concentration ratio of approximately 1,100×. MicroPower modules are therefore expected to support solar concentration ratios up to 1,100×; module optimisation for lower concentration ratios depends on design requirements.

5 · Where CSP fits in the portfolio

CSP is a candidate flagship application for MicroPower at the point where (a) a dish-integrator partner has a commercial path and (b) the post-funding manufacturing line is operational. Today, CSP sits as a credible adjacency to MicroPower's industrial waste-heat work, not an active commercial pipeline.

MicroPower engages with dish-CSP integrators interested in solid-state conversion at the receiver. Introductions and structured enquiries are welcome via the MicroPower Global contact page.

References

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