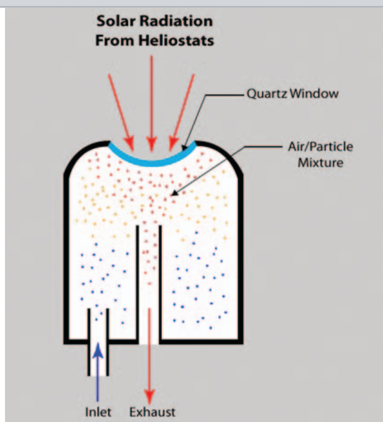
Small-Particle Solar Receiver for High-Temperature Brayton Power Cycles

SAN DIEGO STATE UNIVERSITY

PROGRAM:	SunShot CSP R&D 2012
TOPIC:	Advanced Receivers
LOCATION:	San Diego, California
AWARD AMOUNT:	Up to $3.8 million
PROJECT TERM:	2012–2016



This conceptual schematic shows a small particle solar receiver. Concentrated radiation from the heliostat field is absorbed directly in a gas-particle suspension rather than on the receiver walls. The carbon nanoparticles oxidize as they transit the receiver, resulting in a clear gas stream exiting toward the turbine. *Illustration from San Diego State University*

MOTIVATION

Central receiver power plants that incorporate a gas-based Brayton cycle rather than a steam-based Rankine cycle can increase plant efficiency and eliminate the need for cooling water. In addition, the concept of a small-particle receiver offers further advantages over competing gas-cooled receiver designs. Based on previous 30-kW tests and subsequent numerical modeling, the Small Particle Heat Exchange Receiver (SPHER) represents a gas-cooled central receiver capable of producing pressurized air in excess of 1,000°C.

PROJECT DESCRIPTION

The objective of this project is to validate, through on-sun testing, the viability of the SPHER concept. This concept uses carbon nanoparticles dispersed in air to absorb highly concentrated solar flux inside a windowed pressure vessel, rather than on a solid surface as in most other receivers. The research team is demonstrating the use of a large, pressurized window, particle generator, and unique receiver configuration to produce a low-cost, high-efficiency, reliable, high-temperature receiver that is capable of powering a gas turbine for electricity production.

IMPACT

If successful, this project team would build the first large-scale, pressurized, high-temperature, gas-cooled solar receiver capable of being deployed commercially. While the proposed use for this receiver is to drive a gas turbine, such a receiver could also be used to produce high-temperature process heat and for solar processing of fuels and chemicals.

CONTACTS

Project Leader:

Dr. Fletcher Miller
fletcher.miller@sdsu.edu

Partnering Organizations:

- L-3 Integrated Optical Systems
- Pratt & Whitney Rocketdyne
- Solar Thermal Consulting
- Solar Turbines Incorporated

For more information, visit the project page at: www.solar.energy.gov/sunshot/csp_sunshotrnd_sdsu.html.

eere.energy.gov • energy.gov/sunshot
DOE/GO-102012-3671 • September 2012

Printed with a renewable-source ink on paper containing at least 50% wastepaper, including 10% post consumer waste.

U.S. DEPARTMENT OF ENERGY