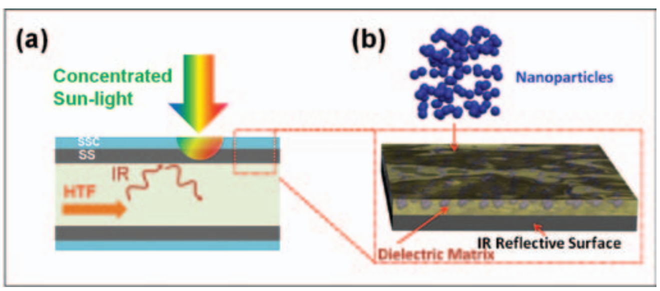
High-Performance Nanostructured Coating

UNIVERSITY OF CALIFORNIA SAN DIEGO

PROGRAM:	SunShot CSP R&D 2012
TOPIC:	Advanced Receivers
LOCATION:	La Jolla, California
AWARD AMOUNT:	Up to $1.0 million
PROJECT TERM:	2012–2014



Schematic of the proposed spectral selective coating (SSC). The illustration on the left shows how concentrated sunlight is absorbed by the SSC layer on a stainless steel tube to raise the temperature of the heat transfer fluid. On the right, the SSC with nanoparticles is embedded in a dielectric matrix. *Illustration from University of California San Diego*

MOTIVATION

Receiver surfaces used in concentrating solar power (CSP) systems rely on high-temperature, spectrally selective coatings (SSCs) to effectively absorb solar energy without emitting much blackbody radiation. Two of the major operating and maintenance issues for parabolic trough plants are minimizing heat loss and the eventual replacement of coatings and receivers. The issues are expected to be more severe in power tower systems, which operate at higher optical concentration ratios and temperatures. An ideal SSC would possess high spectral absorptivity in the solar spectrum and low spectral emissivity in the infrared spectrum, as well as excellent durability at elevated temperatures in open air.

PROJECT DESCRIPTION

The University of California San Diego research team is working to develop a new high-temperature SSC for receiver surfaces. The coating employs surface-protected semiconductor nanoparticles to drastically reduce heat loss and allow for higher temperature receiver operation. Numeric modeling is being used to guide the material composition, size distribution, and morphology of the nanoparticles. In addition, the team is developing a low-cost technique for generating this innovative coating.

IMPACT

The optical properties of the SSC directly determine the efficiency and maximum attainable temperature of solar receivers, which in turn influence the power-conversion efficiency and overall system cost. The proposed SSCs are aimed at achieving solar absorptance of $> 94\%$ and infrared emittance of $< 7\%$ at 750°C. These achievements can enable thermal receiver efficiencies of $> 90\%$ and operation temperatures of heat-transfer fluids above 650°C.

CONTACTS

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

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