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Solar Selective Absorption Coatings for Concentrating Solar Receivers

Spinal oxides are intrinsically solar-selective and stable at high temperatures.

Increasing solar absorption and minimizing emissivity at high temperatures leads to more efficient energy

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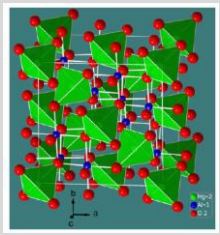
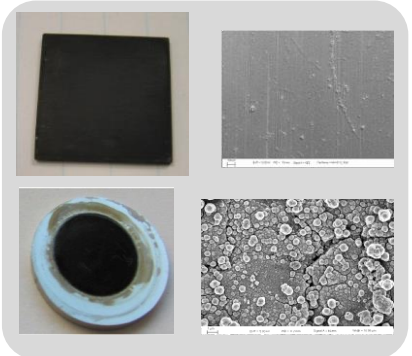
Problem Statement:

Next-generation solar power towers operating at 650°C and above will require receiver coatings that selectively absorb as much energy as possible while minimizing IR heat loss. The industry standard, Pyromark®, has a high solar absorptance (α > 0.95), but also high emittance (ε ~0.87). Sandia is developing new selective receiver coatings that maintain high solar spectrum absorptance, low emittance, and that are stable in air, easily applied at large scales, cost effective, and survive thousands of heating and cooling cycles.


Spinel structure

Approach:

Sandia is utilizing solution-based spin coating and electrodeposition methods to enable the facile synthesis of coatings with varying formulations and dopant concentrations. Such methods allow for rapid deposition and optical screening of multiple compositions. Current compositions focus on spinel oxides that are intrinsically solar-selective, are stable in an air environment at temperatures in excess of 650 °C, and can be applied to the receiver surface in an manufacturing environment or in the field. We are exploring modifying surface morphology by introducing pore formers in thermally sprayed coatings and deposition geometry of refractory metals to tailor the optical properties. Finally, we are investigating thermal spray as a technique to scale-up deposition to large areas.



Impact:

At 650 °C, a reduction in ε from 0.88 to 0.4 will increase the thermal efficiency by 4%; at 800 °C, the same reduction increases the thermal efficiency by 7%. This can result in a decrease in the levelized cost of energy (LCOE) of at least 0.25¢/kWh.

U.S. DEPARTMENT OF ENERGY | NNSA National Nuclear Security Administration

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