Next Generation Solar Collectors for CSP

3M Company

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PROJECT OBJECTIVES

Goal:
Develop a new set of technology elements, including reflective films, reflector panels, framing structural elements and dual axis drives
Design and build a large format heliostat design incorporating these new technology elements
Install and field test the heliostat design at the National Solar Thermal Test Facility (at Sandia National Laboratories)
Analyze the impact of new heliostat design on LCOE

- *These development will lead to the lowest "on target solar flux per dollar"*

Innovation: The use of space frame, continuous tracking, and light-weight reflectors with polymeric reflective film will provide a unique technology set for heliostats with potential for higher performance at lower cost.

- *The use of lightweight reflectors based on polymer based mirrors (vs. glass mirrors) has not been systematically explored in the past*

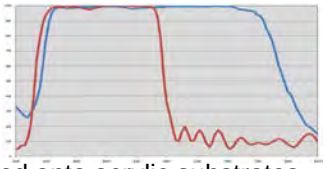
Milestones: No milestones for this quarter

APPROACH

- Lab scale extrusion trials are used to identify compatibility of material sets and prepare samples for subsequent optical and weathering studies for polymeric solar mirror films
- Polymeric mirror films will be metalized for high solar reflectance
- Metalized mirror films will be fabricated into reflectors for heliostats
- A low-cost supporting panel (MTTS) for the mirror film will be developed using lower-cost raw materials and innovative design and process changes
- Space-frame designs, to support the reflective panels, will be designed and evaluated for optimal performance / cost
- Adaptive optics and continuous tracking system will be developed to complete the heliostat design

KEY RESULTS AND OUTCOMES

- A pilot scale extrusion experiment was completed to create a wider reflectance band material (shown in blue) and samples were produced for hard-coating and vapor coating trials



- Six UVA packages were prepared and coated onto acrylic substrates. These samples are in accelerated weathering chambers to evaluate the retention of optical density of the uva package as it ages
- A cost analysis on the MTTS panel has been done with key cost reduction areas identified.
- 400 hrs of UV weathering of adhesive for MTTS panel completed with no degradation in performance
- First round of slope error measurements on MTTS panels completed with high density VSHOT scans showing < 1.5 mrad slope error in y-direction but ~ 2 mrad in the x-direction

NEXT MILESTONES

- Complete metallization of mirror films for accelerated weathering studies.
- Create samples of uva packages with antioxidants for optical density studies under accelerated weathering. Coatings will be applied to both acrylic and mirror substrates for comparison.
- MTTS panels will be made using various thickness' of steel and adhesive types. These will be tested for shape accuracy using high density scans on the VSHOT. Particular attention will be given to forming process parameters in order to bring the dz/dx slope error numbers closer to the target of < 1.5 mrad.
- Modeling and ray tracing will be used to understand the effect of support spacing and panel material thickness on the reflected beam deviations. Wind load simulations are also planned.