



# **Optical Materials, Adhesive and Encapsulant, III-V, and Optical Characterization Evaluation**

## **Cooperative Research and Development Final Report**

**CRADA Number: CRD-07-216**

NREL Technical Contact: Michael Kempe

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**CRADA Report**  
NREL/TP-7A10-55834  
November 2012

Contract No. DE-AC36-08GO28308

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## **Cooperative Research and Development Final Report**

In accordance with Requirements set forth in Article XI.A(3) of the CRADA document, this document is the final CRADA report, including a list of Subject Inventions, to be forwarded to the Office of Science and Technical Information as part of the commitment to the public to demonstrate results of federally funded research.

**CRADA Number:** CRD-07-216

**CRADA Title:** Optical Materials, Adhesive and Encapsulant, III-V, and Optical Characterization Evaluation

**Parties to the Agreement:** SolFocus

### **Joint Work Statement Funding Table showing DOE commitment:**

Estimated Costs	NREL Shared Resources
Year 1	\$ 00.00
Year 2	\$ 00.00
Year 3	\$ 00.00
TOTALS	\$ 00.00

### **Abstract of CRADA work:**

SolFocus is currently developing solar technology for utility scale application using Winston collector based concentrating photovoltaics (CPV). Part of that technology development includes small mirror dishes and front surface reflectors, and bonding the separate parts to the assembly. Mirror panels must meet rigid optical specifications in terms of radius of curvature, slope errors and specularity. The reflective surfaces must demonstrate long term durability and maintain high reflectivity. Some bonded surfaces must maintain adhesion and transparency under high concentrations and high temperatures. Others will experience moderate temperatures and do not require transparency. NREL researchers have developed methods and tools that address these related areas.

### **Summary of Research Results:**

Cheryl Kennedy began testing the durability of SolFocus mirrors in 2007 under the CRADA. The initial mirrors were of poor quality. She attended a SolFocus tiger team meeting to analyze their mirror reliability issues in August 2008, visiting the SolFocus headquarters and a nearby demonstration system. Kennedy presented common mirror reliability issues and SolFocus presented their current mirror process issues. The root cause of the reliability issues was determined after discussion with the tiger team. SolFocus used this information to change their mirroring process and began producing reliable solar mirrors.

Over the course of about 6 years a total of 19 different candidate adhesive materials were investigated by Mike Kempe for use in the CPV system of Solfocus. These materials were used to bond two pieces of

glass in either a lap shear (3 materials) or a butt joint configuration (16 sample sets). Samples were exposed for up to 8000 h in an Atlas Ci4000 WeatherOmeter (WOM) set up with an ambient temperature of 60°C, a black panel temperature of 95°C, a relative humidity of 60%, and an irradiance of 114 W/m<sup>2</sup> between 300 and 400 nm. Some materials were found to maintain excellent adhesion over the course of this exposure, and others were found to decompose, delaminate, or creep because of exposure. SolFocus has used this data to aid in selection of their adhesives.

Additionally, cell assemblies were similarly stressed in the Atlas Ci4000 WOM. This allowed the simultaneous application of heat, humidity, light, and voltage to the cells. These cells were also fitted with a lens to provide concentrated light, though only over a small portion of the cell. While this did not duplicate the high intensity light of the actual use condition, it did highlight some concerns with the durability of the cell materials.

Lastly some receiver assemblies were subjected to a rapid thermo cycling test between -40 and 85°C for a thousand cycles. Cells were heated by the application of current directly to the cells, and cooled by blowing air chilled with dry ice over them. This experiment helped establish the high durability of their receivers to this sort of stress.

Sarah Kurtz joined the SolFocus advisory board in 2007 under the CRADA. She joined an Advisory Board meeting in fall of 2007, visiting the SolFocus headquarters and a nearby demonstration system. SolFocus presented their current product and modifications that they were planning for the product for comment/discussion by the board members.

**Subject Inventions Listing:**

There were no inventions made during the course of these experiments.

**Report Date:**

8/23/12

**Responsible Technical Contact at Alliance/NREL:**

Michael Kempe

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