



Exploration of Novel Reaction Pathway for Formation of Copper Indium Gallium Diselenide

Cooperative Research and Development Final Report

CRADA Number: CRD-03-121

NREL Technical Contact: Maikel van Hest

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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-03-121

Parties to the Agreement: HelioVolt

CRADA Title: Exploration of Novel Reaction Pathway for Formation of Copper Indium Gallium Diselenide

Joint Work Statement Funding Table Showing DOE Commitment:

Estimated Costs	NREL Shared Resources
2003	\$26,531.00
2007	\$25,000.00
2008	\$140,000.00
2009	\$200,000.00
2010	\$250,000.00
2011	\$2,897.00
2013	1,091.00
TOTAL	\$645,519.00

Abstract of CRADA Work:

The investigation will explore a potentially low-cost method of forming CIGS for use in solar cells. Investigators from HelioVolt will work in NREL laboratories to modify and apply our tools in fabrication of the CIGS layer. Investigators from NREL will assist in preparing substrates and in completing solar cells composed of these CIGS layers to evaluate the effectiveness of the HelioVolt processes.

Summary of Research Results:

The NREL and Heliovolt collaborative research has been successful in identifying solution routes to CIGS absorber layer fabrication. In addition to this, the team was also able to improve the other layers in the photovoltaic devices. The team identified an improved buffer material. In situ characterization was also developed.

Subject Inventions Listing: See attached list

Report Date: 11/7/2014

Responsible Technical Contact at Alliance/NREL: Maikel van Hest

This document contains NO confidential, protectable, or proprietary information.

ATTACHMENT TO FINAL REPORT

HelioVolt Corporation- CRD-03-121

- ROI-07-00018 - Liquid Precursors for Formation of CIS Films
- ROI-07-00038 - New Organometallic Gallium Selenide Precursor as Ink Component for Solution Based CIGS Film Deposition
- ROI-08-00023 - (Methods of Making Copper Selenide Precursor Compositions with a Targeted Copper Selenide Content and Precursor Compositions and Thin Films Resulting Therefrom
- ROI-08-00071 - Precursor Ink for Deposition of In-Ga-Se Films
- ROI-09-00033 - Liquid Precursor for Deposition of Copper Selenide and Fabrication of Copper Indium Gallium Diselenide (CIGS) Solar Cells
- ROI-09-00068 - Liquid Precursor for Deposition of Indium Selenide
- ROI-12-00029 - Gallium sulfide buffer layer in thin film PV cells
- ROI-12-00030 - Optical Absorbance Spectroscopy to Determine Selenium Partial Pressure
- ROI-10-00019 - Soluble Aqueous-Phase Precursors For Thin Film Deposition of Chalcogenide, Metal-Chalcogenide, and Mixed Metal-Chalcogenide Materials
- ROI-10-00020 - Synthetic Route to Liquid Precursors for Deposition of Binary Cu-Se, In-Se and Ga-Se Films and Mixed Films Including In-Ga-Se and Cu-In-Ga-Se
- ROI-10-00025 - Synthetic Route to Liquid Precursors for Deposition of Binary Zn-Se, Sn-Se, Zn-S and Sn-S Films and Mixed Films Including Cu-Sn-Se, Cu-Zn-Se, Cu-Sn-S, Cu-Zn-S, Cu-Zn-Sn-S, Cu-Zn-Sn-Se and Cu-Zn-Sn-Se-S
- ROI-11-00017 - Inks for Deposition of Copper Zinc Tin Sulfide (CZTS) Using Cystine as the Sulfur Source
- ROI-11-00058 - Liquid Precursors for Deposition of In-Se, Ga-Se and In-Ga-Se
- ROI-11-00100 - Amorphous Zinc Tin Oxide for use as the Intrinsic Layer in CIGS Solar Devices