NREL
NATIONAL RENEWABLE ENERGY LABORATORY

Development of Thin Film Silicon Solar Cell Using Inkjet Printed Silicon and Other Inkjet Processes

Cooperative Research and Development Final Report

CRADA Number: CRD-07-260

NREL Technical Contact: Bhushan Sopori

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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-07-260 (WR91)

CRADA Title: Development of Thin Film Silicon Solar Cell Using Inkjet Printed Silicon and Other Inkjet Processes

Parties to the Agreement: Silexos

Joint Work Statement Funding Table showing DOE commitment:

Estimated Costs	**NREL** Shared Resources
Year 1	$ 00.00
Year 2	$ 80,000.00
Year 3	$ 00.00
TOTALS	$ 80,000.00

Abstract of CRADA work:

The cost of silicon photovoltaics (Si-PV) can be greatly lowered by developing thin-film crystalline Si solar cells on glass or an equally lower cost substrate. Typically, Si film is deposited by thermal evaporation, plasma enhanced chemical vapor deposition, and sputtering. NREL and Silexos have worked under a CRADA to develop technology to make very low cost solar cells using liquid organic precursors. Typically, cyclopentasilane (CPS) is deposited on a glass substrate and then converted into an a-Si film by UV polymerization followed by low-temperature optical process that crystallizes the amorphous layer. This technique promises to be a very low cost approach for making a Si film.

Summary of Research Results:

Because CPS is a pyrophoric material, this work has to be done is a highly controlled ambient of very low oxygen and moisture, in a glove box. CPS is a thin monomer that does not like to stick to glass and, even when it does, it is extremely difficult to make 1 μm or thicker films. We were able to overcome these difficulties and we were able to make thick films of crystallized silicon. We also studied methods to make heterojunctions devices.

A number of large-area, thick films were prepared by applying principles interface engineering to study effect of interface roughness on the adhesion of the amorphous silicon film. The films ranged between 1 μm and 6 μm in thickness. We were also able to convert these thick a-Si films into small grain crystalline films. We also successfully prepared ZnO:Al/(n)Si heterojunctions. These devices have shown record high open circuit voltages. Fully finished cells were not made.

Subject Inventions listing:

ROI-10-24: Thin Film Heterojunction Silicon Solar Cells

Report Date: 2/21/12 Responsible Technical Contact at Alliance/NREL: Bhushan Sopori

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