NREL
NATIONAL RENEWABLE ENERGY LABORATORY

Joint Development of Coated Conductor and Low Cost Thin Film Solar Cells

Cooperative Research and Development Final Report

CRADA Number: CRD-007-213

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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-007-213

CRADA Title: Joint Development of Coated Conductor and Low Cost Thin Film Solar Cells

Parties to the Agreement: UES, Inc. + NREL

Joint Work Statement Funding Table showing DOE commitment:

Estimated Costs	**NREL** Shared Resources
Year 1	$100,000
Year 2	$100,000
Year 3	$100,000
TOTALS	$300,000

Abstract of CRADA work:

UES has developed a Metal Organic Deposition (MOD) technique for the processing of high temperature superconducting YBaCuO film under funding from Air Force. These films have shown high current carrying capability when deposited on suitable buffered metal tapes. The state-of-the-art buffered metal tapes are prepared by high vacuum based, expensive vapor deposition processes. This makes the current production methods for coated conductors cost prohibitive for large scale commercial production. NREL (Dr. R. Bhattacharya and colleagues) has been developing a low-cost, solution based process for buffer layer deposition on metal tapes. UES has been working with NREL in combining the technologies for a low-cost coated conductor fabrication. UES would like to continue this development using its own funding while NREL may continue to provide the new buffered material as they are being developed.

Low-cost processing technology for CIGS absorber is required for large-area, large scale industrial PV module productions. Fabrication of CIGS thin film absorber using MOD approach is a cost effective, non-vacuum method for scale-up to large area PV modules. UES plans on developing CIGS thin films by using Metal Organic Deposition (MOD) technique as it is a low-cost, non-vacuum method for scale-up to large area PV modules. NREL will support UES, Inc. through expert

processing, characterization and device fabrication. NREL scientists will also help develop a processing phase diagram which includes composition, film thickness, annealing temperature and ambient conditions. Routine measurements of devices and materials will be done under NREL's core support project.

Summary of Research Results:

High-performance MOD YBCO film was demonstrated on an electrodeposited buffer layer. The high-current-carrying YBCO conductor was fabricated on a simplified two-layer buffer architecture. Nonvacuum electrodeposition (ED) was used to prepare a biaxially textured $Gd_2Zr_2O_7$ (GZO) buffer layer on a Ni-W substrates. The GZO buffer layer was capped with a pulsed laser deposited (PLD) CeO_2 layer. The $YBa_2Cu_3O_{7-\delta}$ (YBCO) superconductor was deposited by metallorganic deposition (MOD) on a simplified ED-GZO/PLD-CeO_2 buffer layer. The buffer layers and YBCO superconductor were characterized by X-ray diffraction (including $\theta/2\theta$, pole figure, omega scans, and phi scans), and atomic force microscopy (AFM). Full-width at half maximum values of the omega (ω) and phi (Φ) scans of the electrodeposited GZO layer were better than those of the Ni-W base substrate. At 77 K and a self-magnetic field, the critical current density of MOD YBCO on the electrodeposited-based buffer layer was 1.31×10^6 A/cm^2, using the field criterion of 1 μV/cm.

We published the following joint paper:

1. Raghu N. Bhattacharya, Sovannary Phok, Yongli Xu, and Rabi Bhattacharya, "Electrodeposited biaxially textured buffer layers for YBCO superconductors," IEEE Transaction of ASC, Seattle **17**, No.2 3321-3324 (2007).

Subject Inventions listing: None

Report Date: 8/7/10 Responsible Technical Contact at Alliance/NREL: Bhattacharya, Raghu

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