National Renewable Energy Laboratory
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Office of Energy Efficiency & Renewable Energy
Innovation for Our Energy Future

Thin Film Solar Cells Derived from Sintered Semiconductor Quantum Dots

Cooperative Research and Development Final Report

CRADA Number: CRD-07-00226

NREL Technical Contact: David S. Ginley

CRADA Report
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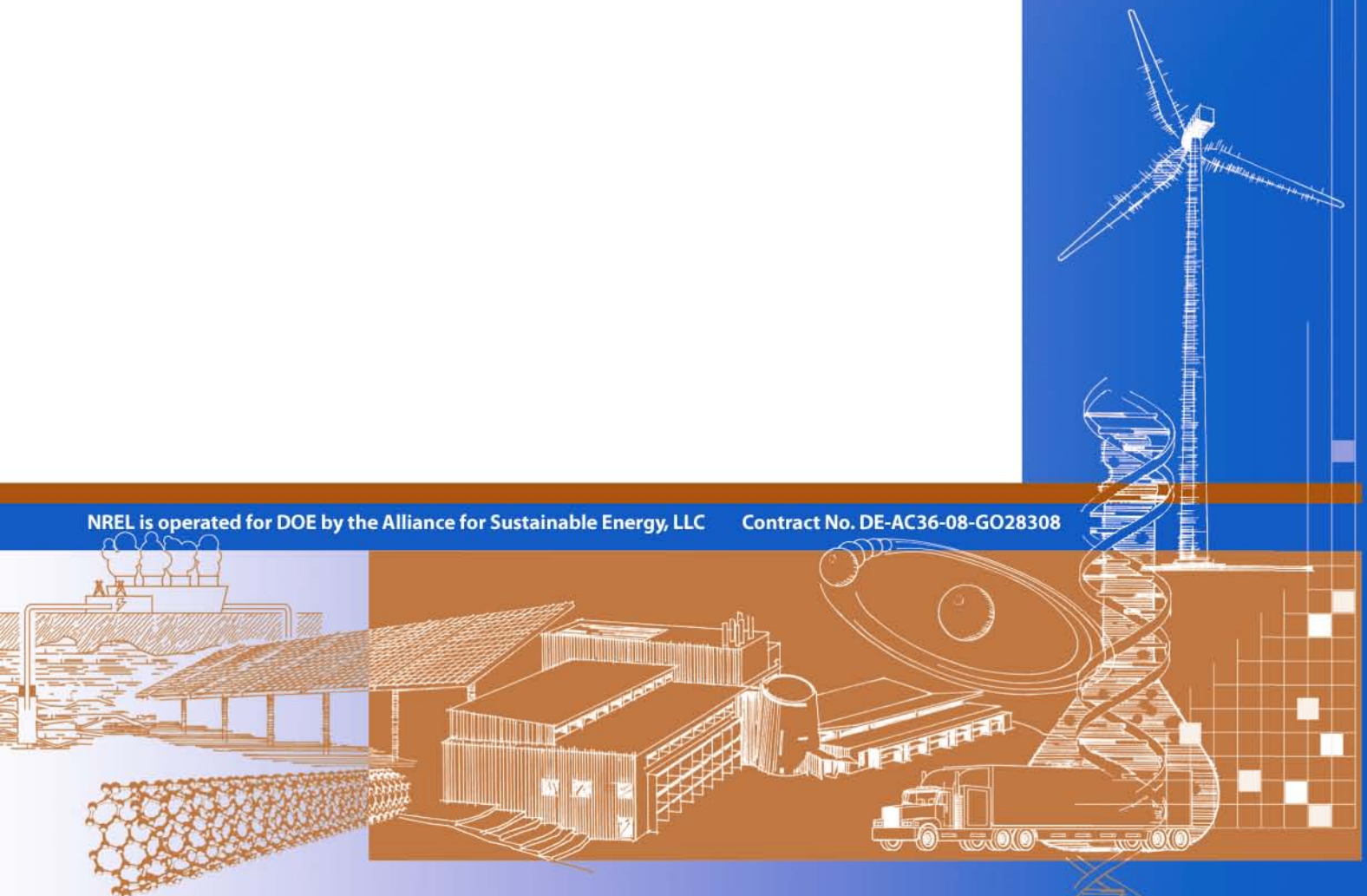

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Cooperative Research and Development Final Report

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-07-00226

CRADA Title: Thin Film Solar Cells Derived from Sintered Semiconductor Quantum Dots

Parties to the Agreement: Evident Technologies, Inc. + NREL

Joint Work Statement Funding Table showing DOE commitment:

Estimated Costs	**NREL** Shared Resources
Year 1	$ 150,000.00
Year 2	$ 400,000.00
Year 3	$ 350,000.00
TOTALS	$ 900,000.00

Abstract of CRADA work:

The NREL/Evident team will develop techniques to fabricate thin film solar cells where the absorption layers comprising the solar cells are derived from sintered semiconductor quantum dots. In the first phase of research the team will reproduce and characterize mixed metal chalcogenide ($CuInGaSe_2$, $CuInGaS_2$, CdTe) thin films and solar cells fabricated from those same thin films using the techniques that previously established by Dr. David Ginley at NREL.

The team will proceed to further optimize the composition of the quantum dot and multiple quantum dot precursors from which the mixed metal chalcogenide ($CuInGaSe_2$, $CuInGaS_2$, CdTe) absorber layer of the solar cells are fabricated. In this stage the team will also investigate and optimize the methods by which the quantum dots are deposited, sintered, and post treated with the aim of achieving solar cells having photo electric conversion efficiencies greater than 10%.

Lastly the team will explore thin film solar cells derived where the absorber layers are derived from sintered semiconductor quantum dots having unique and heretofore unexplored compositions. The team will synthesize novel quantum dots controlling for composition, size, size distribution, and surface chemistry. The team will then fabricate and characterize solar cells using the novel quantum dots as thin film precursors.

Summary of Research Results:

The objective of this task was to transfer the technology and techniques related to thin film solar cells derived from mixed metal cuprate chalcogenides (CuInGaSe, CuInGaS and derivation thereof also denoted by “CIGS”) precursors that were previously developed at NREL to Evident. Specifically the team established that the 7% conversion efficiencies that were previously reported by NREL can be reproduced by Evident researchers. The team used the “CIGS” quantum dots already developed by Evident to make and characterize solar cells in accordance with the deposition, sintering and post processing techniques established by NREL.

The objective of this second task was to transfer the technology and techniques related to thin film solar cells derived from cadmium telluride also denoted CdTe) precursors that were previously developed at NREL to Evident. Specifically the team established that the 10% conversion efficiencies that were previously reported by NREL can be reproduced by Evident’s researchers. The team used the CdTe quantum dots already developed by Evident to make and characterize solar cells in accordance with the deposition, sintering and post processing techniques established by NREL.

In this third task, Evident and NREL explored different routes to fabricate “CIGS” and CdTe thin film solar cells derived from semiconductor quantum dots. The specific aim of this task was to increase the ultimate conversion efficiency of the ensuing solar cells as well as minimize the costs involved in the precursors and construction (deposition and sintering) methodologies. The team investigated techniques to fabricate thin films derived from more than one quantum dot precursor where each precursor contains a subset of the elements of the final “CIGS” or CdTe film. The team also optimized the deposition, sintering, film post processing methods as well as construct and characterize solar cells.

In this fourth and final task, Evident and NREL explored altogether different compositions of quantum dots and use those quantum dots as precursors to deposit and sinter thin film absorber layer that was further used to make solar cells. The specific aim of this task was to increase the ultimate conversion efficiency of the ensuing solar cells as well as minimize the costs involved in the precursors and construction (deposition and sintering) methodologies. The team investigated techniques to fabricate thin films derived from more than one quantum dot precursor where each precursor contained a subset of the elements of the final material for the absorber film. The team also optimized the deposition, sintering, film post processing methods as well as construct and characterize solar cells.

Subject Inventions listing: None.

Report Date: 3/1/10Responsible Technical Contact at Alliance/NREL: Ginley, David S.

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