

# PROCEEDINGS OF SPIE

## ***Thin Film Solar Technology III***

**Louay A. Eldada**

*Editor*

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# Contents

- vii *Conference Committee*
- ix *Introduction*
- xi *Solar Energy Grid Integration Systems (SEGIS): adding functionality while maintaining reliability and economics (Plenary Paper) [811202]*  
W. Bower, Sandia National Labs. (United States)

---

## CIGS PHOTOVOLTAIC DEVICES AND MODULES

---

- 8110 07 **Solution-based precursors in conjunction with rapid optical processing for high-quality hybrid CIGS (Invited Paper) [8110-06]**  
P. A. Hersh, HeliVolt Corp. (United States); C. J. Curtis, M. F. A. M. van Hest, S. E. Habas, A. Miedaner, D. S. Ginley, National Renewable Energy Lab. (United States); B. J. Stanbery, HeliVolt Corp. (United States)
- 8110 08 **Characteristics of CIGS thin films prepared by RF sputtering employing CIGS single target [8110-07]**  
T.-W. Kim, Y.-B. Kim, S.-I. Song, C.-W. Jung, J.-H. Lee, Korea Institute of Industrial Technology (Korea, Republic of)
- 8110 09 **Synthesis and electrophoretic deposition of composite metal nanoparticles and non-vacuum fabrication of CuInSe<sub>2</sub> solar cells [8110-08]**  
W. Guo, K. Hagedorn, B. Liu, IMRA America, Inc. (United States)

---

## PHOTONIC AND PLASMONIC LIGHT MANAGEMENT IN PHOTOVOLTAICS

---

- 8110 0D **Effects of metallic nanoparticle arrays in Si solar cell structures [8110-11]**  
T. Benkenstein, M. Flämmich, T. Harzendorf, Fraunhofer-Institut für Angewandte Optik und Feinmechanik (Germany); T. Käsebier, Friedrich-Schiller-Univ. Jena (Germany); D. Michaelis, M. Oliva, C. Wächter, U. Zeitner, Fraunhofer-Institut für Angewandte Optik und Feinmechanik (Germany)
- 8110 0E **Light trapping in thin film silicon solar cells: an assessment (Invited Paper) [8110-12]**  
H. Zhao, E. A. Schiff, Syracuse Univ. (United States); L. Sivec, J. Yang, S. Guha, United Solar Ovonic, LLC (United States)
- 8110 0F **Enhanced absorption of light due to multiple surface-plasmon-polariton waves [8110-13]**  
M. Faryad, A. Lakhtakia, The Pennsylvania State Univ. (United States)

---

## CHARACTERIZATION AND MEASUREMENT OF SOLAR CELLS AND MODULES

---

- 8110 0G **Measurement and analysis of non-uniformities in CdTe solar cells (Invited Paper) [8110-14]**  
J. R. Sites, Colorado State Univ. (United States)

- 8110 0I **Hall measurements on low-mobility materials and high resistivity materials** [8110-16]  
J. Lindemuth, Lake Shore Cryotronics, Inc. (United States); S.-I. Mizuta, Toyo Corp. (Japan)
- 8110 0K **Stabilization processes and air mass influences for outdoor exposure of thin film modules** [8110-18]  
J. Wirth, K. Scharmach, K.-A. Weiss, M. Köhl, Fraunhofer-Institut für Solare Energiesysteme (Germany)

---

#### AMORPHOUS, NANOSTRUCTURED, AND TEXTURED PHOTOVOLTAICS

---

- 8110 0L **Application of nanostructured silicon to manufacturing of solar cells** [8110-21]  
A. Luchenko, V. Lashkaryov Institute of Semiconductor Physics (Ukraine); T. Bilyk, Kiev National Technical Univ. (Ukraine); M. M. Melnichenko, National Taras Shevchenko Univ. of Kyiv (Ukraine); O. M. Shmyryeva, Kiev National Technical Univ. (Ukraine); K. Svezhentsova, V. Lashkaryov Institute of Semiconductor Physics (Ukraine)
- 8110 0M **Conductive conformal thin film coatings for textured PV: ALD versus sputtering** [8110-22]  
A. Dameron, S. Christensen, M. Galante, J. Berry, D. Gillaspie, J. Perkins, D. Ginley, T. Gennett, National Renewable Energy Lab. (United States)

---

#### NOVEL THIN FILM PHOTOVOLTAIC DEVICES

---

- 8110 0N **Colloidal quantum dot photovoltaics (Invited Paper)** [8110-23]  
S. M. Thon, E. H. Sargent, Univ. of Toronto (Canada)
- 8110 0O **Low-cost fabrication of improved n-Si/p-AgGaSe<sub>2</sub> heterojunction solar cells** [8110-24]  
S. Das, K. C. Mandal, Univ. of South Carolina (United States)
- 8110 0P **Minority carrier transport length in electrodeposited Cu<sub>2</sub>O for heterojunction solar cells** [8110-25]  
Y. Liu, H. K. Turley, J. R. Tumbleston, R. Lopez, The Univ. of North Carolina at Chapel Hill (United States)

---

#### THIN FILM PV AND GRID PARITY

---

- 8110 0Q **Application of electrochemical deposition techniques to thin film solar cell processing (Invited Paper)** [8110-26]  
B. M. Başol, EncoreSolar, Inc. (United States)
- 8110 0R **CdTe, CIGS and a-Si thin film PV technologies: factors impacting LCOE** [8110-27]  
L. Eldada, SunEdison (United States)
- 8110 0S **Novel concepts for low-cost and high-efficient thin film solar cells** [8110-28]  
D. Gómez, A. Menéndez, P. Sánchez, A. Martínez, L. J. Andrés, M. F. Menéndez, N. Campos, A. García, ITMA Materials Technology (Spain); B. Sánchez, Acciona Instalaciones (Spain)

---

## PV MODULE PATTERNING AND PACKAGING

---

- 8110 OT **Laser-induced localized strain and ultrafast absorption in the ablation of thin film solar cells** [8110-29]  
S. Buratin, E. Favero, P. Villaresi, Univ. degli Studi di Padova (Italy)
- 8110 OU **Novel methods of bonding solar cells** [8110-30]  
R. Thomaier, NuSil Technology LLC (United States)
- 8110 OV **Multilayer front-sheet for solar modules with tuned color appearance** [8110-31]  
H. Rooms, I. Barbu, Z. Vroon, R. Meertens, B. Vermeulen, TNO (Netherlands)

---

## POSTER SESSION

---

- 8110 OW **Fabrication and properties of mechanically grooved silicon solar cells with buried contact Cu electrode** [8110-19]  
P. Jang, C.-S. Jung, K.-H. Kim, S. Kyu, Cheongju Univ. (Korea, Republic of)
- 8110 OX **Physical properties of Al-doped MgZnO film grown by RF magnetron sputtering using ZnO/MgO/Al<sub>2</sub>O<sub>3</sub> target** [8110-32]  
K.-P. Hsueh, Y.-C. Cheng, W.-Y. Lin, Vanung Univ. (Taiwan); H.-C. Chiu, Chang Gung Univ. (Taiwan); Y.-P. Huang, G.-C. Chi, National Central Univ. (Taiwan); W.-S. Liu, Yuan Ze Univ. (Taiwan)
- 8110 OZ **The influence of active cell design on a monolithic organic photovoltaic module: fabrication and simulation** [8110-34]  
H.-K. Lyu, J. H. Sim, S. Jeong, S.-H. Woo, Daegu Gyeongbuk Institute of Science & Technology (Korea, Republic of); J.-K. Shin, Kyungpook National Univ. (Korea, Republic of); Y. S. Han, Daegu Gyeongbuk Institute of Science & Technology (Korea, Republic of)
- 8110 11 **Preparation and properties of CdS film used in CIGS-based solar cell with CBD method** [8110-36]  
C. P. Liu, C. L. Chuang, W. H. Wu, T. J. Hsieh, M. W. Chang, Yuan Ze Univ. (Taiwan)
- 8110 13 **Laser scribing performance in thin-film silicon photovoltaic micromorph tandem modules using short pulse lasers** [8110-38]  
J. Cashmore, V. Cervetto, H. Chabane-Amat, M.-H. Lindic, S. Ristau, Oerlikon Solar Ltd. (Switzerland)

*Author Index*



# Conference Committee

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- 1 Film Si Photovoltaics  
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**Charles W. Teplin**, National Renewable Energy Laboratory (United States)
- 2 CZTS Solar Cells  
**Charles W. Teplin**, National Renewable Energy Laboratory (United States)
- 3 CIGS Photovoltaic Devices and Modules  
**Frederic Dross**, IMEC (Belgium)
- 4 Photonic and Plasmonic Light Management in Photovoltaics  
**Louay A. Eldada**, SunEdison (United States)
- 5 Characterization and Measurement of Solar Cells and Modules  
**Shanhui Fan**, Stanford University (United States)

- 6 Amorphous, Nanostructured, and Textured Photovoltaics  
**Eric A. Schiff**, Syracuse University (United States)
- 7 Novel Thin Film Photovoltaic Devices  
**Louay A. Eldada**, SunEdison (United States)
- 8 Thin Film PV and Grid Parity  
**James R. Sites**, Colorado State University (United States)
- 9 PV Module Patterning and Packaging  
**Bulent Basol**, EncoreSolar, Inc. (United States)

## Introduction

The third Thin Film Solar Technology conference was held this year at the SPIE Solar Energy + Technology symposium, and the strong program with stimulating talks from various areas in the field ensured a well-attended and successful event. The conference included speakers from leading academic institutions, government laboratories, and the industry.

This volume features contributions from scientists and engineers in the general area of Thin Film Solar Technology, with special emphasis on Thin Film Photovoltaics (TF PV). Thin film solar technologies are a compelling alternative to conventional crystalline silicon solar technologies because they offer a cost reduction potential, driven mainly by the need for a lower amount of material, as well as the possibility of monolithic integration. It is important to note however that silicon pricing has continued to drop dramatically this year, challenging TF PV manufacturers to further improve the efficiency and reduce the cost of their modules. As a result, this year has seen a shake-out in the TF PV space, resulting in the last few companies in each technology area standing, as well as significant consolidation activity through mergers and acquisitions. The PV industry came out of this period of change stronger.

To illustrate the breadth of topics covered in this conference, we mention just a few of the papers presented in each session. The first session dealt with epitaxial film crystal silicon. Chaz Teplin from the National Renewable Energy Laboratory (NREL) presented a talk on the progress and challenges in low-temperature, high-rate epitaxy for film silicon photovoltaics, which offer low cost potential at high efficiency, as they eliminate the wafer that accounts for a substantial part of the cost of a conventional crystalline Si module, and they can deliver high efficiency to maintain low area-related (BOS, installation) system costs. The second session focused on copper zinc tin sulfide (CZTS). Dongho Lee et al. from the University of Buffalo described the fabrication of CZTS solar cells using spray chemical vapor deposition, and Mowafak Al-Jassim et al. from NREL presented a talk on probing the defect physics of CZTS by luminescence spectrum imaging.

The third session dealt with CIGS photovoltaic devices and modules. Rommel Noufi of NREL gave an overview of the potential, challenges, and opportunities of thin film CIGS solar cells, and Peter Hersh et al. from HelioVolt Corporation and NREL described the use of solution-based precursors in conjunction with rapid thermal processing for the production of high-quality hybrid CIGS. The fourth session covered the emerging field of photonic and plasmonic light management in photovoltaics. Prof. Shanhui Fan et al. from Stanford University gave an overview talk on the field of nanophotonic light management in solar cells, and Prof. Eric Schiff et al. from Syracuse University and United Solar Ovonic

(UniSolar) presented a talk on plasmonic effects and light-trapping in thin-film photovoltaics.

The fifth session focused on the characterization and measurement of solar cells and modules. Prof. Jim Sites from Colorado State University presented an overview talk on the measurement and analysis of non-uniformities in CdTe solar cells, and Karl-Anders Weiss et al. from the Fraunhofer-Institut für Solare Energiesysteme, Germany, described correction methods and stabilization of outdoor measurements of thin film modules. The sixth session dealt with amorphous, nanostructured, and textured photovoltaics. Thomas Gennett et al. from NREL gave a talk on the use of ALD versus sputtering for the deposition of conductive conformal thin film coatings for textured PV. The seventh session covered novel thin film photovoltaic devices. Susanna Thon from Prof. Ted Sargent's group at the University of Toronto presented a talk on recent breakthroughs in the field of colloidal quantum dot photovoltaics, where low-temperature solution-processed quantum dots of the same material but different sizes are used to achieve tunability for efficient photon harvesting over a wide band of the solar spectrum, providing a simple and low-cost path to high-efficiency tandem and triple-junction cells.

The eighth session dealt with thin film PV cost and the progress toward grid parity. Louay Eldada of SunEdison gave an overview of the factors impacting the LCOE (levelized cost of electricity) related to the leading thin film PV technologies (CdTe, CIGS, a-Si) and compared the costs of electricity from these technologies to those of electricity from incumbent PV technologies (multicrystalline and monocrystalline silicon), and Bulent Basol of EncoreSolar described the application of electrochemical deposition techniques to thin film solar cell processing. Finally, the last session of the conference, the ninth session, focused on PV module patterning and packaging. Stefano Buratin et al. from Università degli Studi di Padova, Italy, discussed laser-induced localized strain and ultrafast absorption in the ablation of thin film solar cells, and Harmen Rooms from TNO Science and Industry, the Netherlands, described a technology for a PV module multilayer front-sheet with tuned color appearance.

Although this volume cannot include all the recent important work in the vast field of thin film solar technologies, it does cover a significant cross section of the advances happening globally, and it provides a roadmap for this fast-growing and exciting field by presenting the cutting-edge work and the visions of leading experts who are actively inventing the future.

**Louay Eldada**