PROCEEDINGS OF SPIE

Next Generation (Nano) Photonic and Cell Technologies for Solar Energy Conversion II

Loucas Tsakalakos
Editor

21–23 August 2011
San Diego, California, United States

Sponsored and Published by
SPIE

Volume 8111

Proceedings of SPIE, 0277-786X, v. 8111

The papers included in this volume were part of the technical conference cited on the cover and title page. Papers were selected and subject to review by the editors and conference program committee. Some conference presentations may not be available for publication. The papers published in these proceedings reflect the work and thoughts of the authors and are published herein as submitted. The publisher is not responsible for the validity of the information or for any outcomes resulting from reliance thereon.

Please use the following format to cite material from this book:
Author(s), "Title of Paper," in *Next Generation (Nano) Photonic and Cell Technologies for Solar Energy Conversion II*, edited by Loucas Tsakalakos, Proceedings of SPIE Vol. 8111 (SPIE, Bellingham, WA, 2011) Article CID Number.

ISSN 0277-786X
ISBN 9780819487216

Published by
SPIE
P.O. Box 10, Bellingham, Washington 98227-0010 USA
Telephone +1 360 676 3290 (Pacific Time) · Fax +1 360 647 1445
SPIE.org

Printed in the United States of America.

Publication of record for individual papers is online in the SPIE Digital Library.

SPIEDigitalLibrary.org

Paper Numbering: Proceedings of SPIE follow an e-First publication model, with papers published first online and then in print and on CD-ROM. Papers are published as they are submitted and meet publication criteria. A unique, consistent, permanent citation identifier (CID) number is assigned to each article at the time of the first publication. Utilization of CIDs allows articles to be fully citable as soon as they are published online, and connects the same identifier to all online, print, and electronic versions of the publication. SPIE uses a six-digit CID article numbering system in which:

- The first four digits correspond to the SPIE volume number.
- The last two digits indicate publication order within the volume using a Base 36 numbering system employing both numerals and letters. These two-number sets start with 00, 01, 02, 03, 04, 05, 06, 07, 08, 09, 0A, 0B … 0Z, followed by 10-1Z, 20-2Z, etc.

The CID number appears on each page of the manuscript. The complete citation is used on the first page, and an abbreviated version on subsequent pages. Numbers in the index correspond to the last two digits of the six-digit CID number.

Contents

POSTER SESSION

Conference Committee

Symposium Chair

Martha Symko-Davies, National Renewable Energy Laboratory (United States)

Conference Chair

Loucas Tsakalakos, GE Global Research (United States)

Program Committee

Amanda J. Chatten, Imperial College London (United Kingdom)
Gavin J. Conibeer, ARC Photovoltaics Center of Excellence (Australia)
Alberto Salleo, Stanford University (United States)
Sean E. Shaheen, University of Denver (United States)
Wilfried G. J. H. M. van Sark, Utrecht Universiteit (Netherlands)
Deli Wang, University of California, San Diego (United States)
Xianfan Xu, Purdue University (United States)
Edward T. Yu, The University of Texas at Austin (United States)

Session Chairs

1 Nanophotonics for Photovoltaics I
Loucas Tsakalakos, GE Global Research (United States)

2 Nanophotonics for Photovoltaics II
Loucas Tsakalakos, GE Global Research (United States)

3 Nanophotonics for Photovoltaics III
Loucas Tsakalakos, GE Global Research (United States)

4 Quantum Dot Solar Cells
Sean E. Shaheen, University of Denver (United States)

5 Advanced Solar Energy Conversion Mechanisms I
Alberto Salleo, Stanford University (United States)

6 Advanced Solar Energy Conversion Mechanisms II
Xianfan Xu, Purdue University (United States)

7 Wire-Based Inorganic Solar Cells
Loucas Tsakalakos, GE Global Research (United States)

8 Nanoscale and Hybrid Systems: Joint Session with Conference 8116
Alberto Salleo, Stanford University (United States)

Introduction

The solar energy industry has seen strong growth in the last decade. While the recent Great Recession has certainly had an impact on the photovoltaics (PV) industry, this has not been as severe as feared and the industry is seeing promising growth levels. Conventional silicon and thin film PV technologies are well developed and capable of meeting the clean energy demands of many markets. They will have even more impact as cost reduction and manufacturing technologies improve. Furthermore, the industry is beginning what appears to be a process of consolidation that may be representative of maturity, particularly as competition from low-cost Si manufacturers continues to provide price pressure on modules and ultimately on PV systems. Nevertheless, there continues to be interest within the research community in developing technologies that can simultaneously reduce cost yet also provide breakthrough performance. Today solar technologies that simultaneously provide high performance yet low cost and reliability are not well established or non-existent.

To this effect, research efforts in studying and applying the unique optical, electrical, and structural/architectural properties of micro and nanostructures to solar energy applications, either as novel photonic structures or as new solar cell device structures, continue to flourish. This year's fourth installment of the conference devoted to this topic (8111: Next Generation (Nano) Photonic and Cell Technologies for Solar Energy Conversion II), held at SPIE Optics & Photonics in 2011 as part of the Solar Energy + Technology track, once again demonstrated the strong interest in this field of research.

There were many significant advances presented at the conference, including 7% efficient Si nanowire solar cells, new designs for light trapping and waveguiding in PV devices, improved materials and structures for up and down conversion, demonstration of hot carrier extraction from quantum dot monolayers, high efficiency quantum dot devices, application of metamaterials to PV, use of self-assembly to create photonic structures, and novel organic and hybrid devices (joint session with OPV conference).

The conference was also highlighted by the third year of a panel discussion on Commercialization of Emerging Photovoltaic Technologies, in which experts from academia and industry discussed the prospects and challenges in developing novel PV technologies based on organic and inorganic materials. This year's panelists were as follows:

Martha Symko-Davies, National Renewable Energy Lab. (USA)
Dana Olsen, National Renewable Energy Lab. (USA)
Louay A. Eldada, SunEdison (USA)
Frank van Mierlo, 1366 Technologies, Inc. (USA)

Among the topics discussed by the panel included vertical integration of solar companies, the role of silicon in the future of the PV industry, the effect of Si feedstock impurities, the future of organic PV in the market, cost and reliability of concentrator PV, and next generation concepts.

Once again, the conference provided an excellent forum for the interchange of next generation photonic and device concepts in solar energy conversion. I would like to thank the conference Program Committee (Drs. A. Chatten, G. Conibeer, A. Salleo, S.E. Shaheen, W.G.J.H.M. van Sark, D. Wang, X. Xu, and E.T. Yu) for their great support, as well as the session chairs, authors, and SPIE staff (J. Lowell in particular) for their help in making this a successful conference.

Loucas Tsakalakos