PROCEEDINGS OF SPIE

SPIDigitalLibrary.org/conference-proceedings-of-spie

Front Matter: Volume 8377

, "Front Matter: Volume 8377," Proc. SPIE 8377, Energy Harvesting and Storage: Materials, Devices, and Applications III, 837701 (13 June 2012); doi: 10.1117/12.979365

SPIE.

Event: SPIE Defense, Security, and Sensing, 2012, Baltimore, Maryland, United States

PROCEEDINGS OF SPIE

Energy Harvesting and Storage: Materials, Devices, and Applications III

Nibir K. Dhar
Priyalal S. Wijewarnasuriya
Achyut Dutta
Editors

23–24 April 2012
Baltimore, Maryland, United States

Sponsored and Published by
SPIE

Volume 8377

Proceedings of SPIE, 0277-786X, v. 8377

SPIE is an international society advancing an interdisciplinary approach to the science and application of light.

Energy Harvesting and Storage: Materials, Devices, and Applications III,
edited by Nibir K. Dhar, Priyalal S. Wijewarnasuriya, Achyut Dutta, Proc. of SPIE Vol. 8377,
837701 · © 2012 SPIE · CCC code: 0277-786X/12/\$18 · doi: 10.1117/12.979365

Proc. of SPIE Vol. 8377 837701-1

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 *Energy Harvesting and Storage: Materials, Devices, and Applications III*, edited by Nibir K. Dhar, Priyalal S. Wijewarnasuriya, Achyut Dutta, Proceedings of SPIE Vol. 8377 (SPIE, Bellingham, WA, 2012) Article CID Number.

ISSN 0277-786X

ISBN 9780819490551

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

Copyright © 2012, Society of Photo-Optical Instrumentation Engineers

Copying of material in this book for internal or personal use, or for the internal or personal use of specific clients, beyond the fair use provisions granted by the U.S. Copyright Law is authorized by SPIE subject to payment of copying fees. The Transactional Reporting Service base fee for this volume is \$18.00 per article (or portion thereof), which should be paid directly to the Copyright Clearance Center (CCC), 222 Rosewood Drive, Danvers, MA 01923. Payment may also be made electronically through CCC Online at copyright.com. Other copying for republication, resale, advertising or promotion, or any form of systematic or multiple reproduction of any material in this book is prohibited except with permission in writing from the publisher. The CCC fee code is 0277-786X/12/\$18.00.

Printed in the United States of America.

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

SPIDigitalLibrary.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

vii *Conference Committee*

SESSION 1 **ADVANCED POWER AND ENERGY STORAGE TECHNOLOGIES: BATTERY AND FUEL CELLS**

- 8377 02 **Power and energy research at the Army Research Laboratory (Keynote Paper)** [8377-01]
E. C. Shaffer, M. C. Wood, U.S. Army Research Lab. (United States)
- 8377 03 **Influence of nanosize and thermodynamics on lithium storage in insertion and conversion reactions (Invited Paper)** [8377-02]
S. Hariharan, V. Ramar, P. Balaya, National Univ. of Singapore (Singapore)

SESSION 2 **ADVANCED ENERGY STORAGE TECHNOLOGIES: BATTERY AND FUEL CELLS I**

- 8377 06 **Lightweight carbon nanotube-based structural-energy storage devices for micro unmanned systems** [8377-06]
M. Rivera, D. P. Cole, Mofite Robotics, Inc. (United States); M. G. Hahm, A. L. M. Reddy, R. Vajtai, P. M. Ajayan, Rice Univ. (United States); S. P. Karna, M. L. Bundy, U.S. Army Research Lab. (United States)

SESSION 3 **ADVANCED ENERGY STORAGE TECHNOLOGIES: BATTERY AND FUEL CELLS II**

- 8377 08 **Recent advances in design and fabrication of on-chip micro-supercapacitors (Invited Paper)** [8377-08]
M. Beidaghi, C. Wang, Florida International Univ. (United States)
- 8377 09 **Energy density and rate limitations in structural composite supercapacitors** [8377-09]
J. F. Snyder, E. Gienger, E. D. Wetzel, K. Xu, U.S. Army Research Lab. (United States)
- 8377 0A **Development of biologically modified anodes for energy harvesting using microbial fuel cells** [8377-10]
J. J. Sumner, U.S. Army Research Lab. (United States); R. Ganguli, Teledyne Scientific and Imaging (United States); B. Chmelka, Univ. of California, Santa Barbara (United States)
- 8377 0B **III-V nitride semiconductors for solar hydrogen production** [8377-11]
V. Parameshwaran, Stanford Univ. (United States) and Banpil Photonics, Inc. (United States); C. Gallinat, R. W. Enck, A. V. Sampath, P. H. Shen, U.S. Army Research Lab. (United States); T. Kuykendall, S. Aloni, Lawrence Berkeley National Lab. (United States); M. Wraback, U.S. Army Research Lab. (United States); B. M. Clemens, Stanford Univ. (United States)

SESSION 4 ADVANCED ENERGY HARVESTING TECHNOLOGIES

- 8377 0D **Review of pyroelectric thermal energy harvesting and new MEMs-based resonant energy conversion techniques (Invited Paper)** [8377-13]
S. R. Hunter, N. V. Lavrik, Oak Ridge National Lab. (United States); S. Mostafa, The Univ. of Tennessee (United States); S. Rajic, P. G. Datskos, Oak Ridge National Lab. (United States)
- 8377 0E **Quantum-structured III-V energy harvesting devices: pathways to ultra-high conversion efficiencies (Invited Paper)** [8377-15]
R. E. Welser, A. K. Sood, Magnolia Optical Technologies, Inc. (United States) and Magnolia Solar, Inc. (United States); N. K. Dhar, Defense Advanced Research Projects Agency (United States); P. S. Wijewarnasuriya, U.S. Army Research Lab. (United States)

SESSION 5 ADVANCED ENERGY STORAGE TECHNOLOGIES AND APPLICATIONS

- 8377 0F **Organic semiconductors and their application in energy harvesting (Keynote Paper)** [8377-16]
A. B. Kaul, National Science Foundation (United States)

SESSION 6 ADVANCED THERMOELECTRIC ENERGY TECHNOLOGIES I

- 8377 0H **Scalable thermoelectric (TE) device technologies for power generation** [8377-18]
P. Thomas, B. Cook, D. Stokes, G. Krueger, R. Venkatasubramanian, RTI International (United States)
- 8377 0I **Novel methodology to determine thermal conductivity of thermoelectric materials and comparison with device performance (Invited Paper)** [8377-19]
J. R. Maddux, P. J. Taylor, U.S. Army Research Lab. (United States)

SESSION 7 ADVANCED THERMOELECTRIC ENERGY TECHNOLOGIES II

- 8377 0K **Development of PbTe material for advanced thermoelectric power generation** [8377-21]
N. S. Prasad, NASA Langley Research Ctr. (United States); S. B. Trivedi, W. Palosz, R. Rosemeier, C. Rosemeier, S. Kutcher, D. Mayers, Brimrose Corp. of America (United States); P. J. Taylor, J. Maddux, U.S. Army Research Lab. (United States); J. Singh, The Pennsylvania State Univ. (United States)
- 8377 0L **Universal scaling relations for the thermoelectric power factor of nanostructures** [8377-22]
J. E. Cornett, O. Rabin, Univ. of Maryland (United States)

SESSION 8 ADVANCED THERMOELECTRIC ENERGY TECHNOLOGIES III

- 8377 0N **Thermoelectric waste heat recovery from an M1 Abrams tank** [8377-24]
C. D. Stokes, P. M. Thomas, N. G. Baldasaro, M. J. Mantini, R. Venkatasubramanian, RTI International (United States); M. D. Barton, Create, Inc. (United States); C. V. Cardine, General Dynamics Land Systems (United States); G. W. Walker, Old Dominion Univ. (United States)

- 8377 0O **Two-cavity MEMS capacitive power scavenger** [8377-25]
J. Lin, J. Zhu, Z. Feng, M. Almasri, Univ. of Missouri-Columbia (United States)
- 8377 0P **MEMS capacitors with dual cavity for power harvesting** [8377-26]
N. S. Yuksek, J. Zhu, Z. C. Feng, M. Almasri, Univ. of Missouri-Columbia (United States)

SESSION 9 ADVANCED THERMOELECTRIC ENERGY TECHNOLOGIES IV

- 8377 0R **Alpha Schottky junction energy source** [8377-28]
M. S. Litz, U.S. Army Research Lab. (United States); Z. Fan, Texas Tech Univ. (United States);
J. J. Carroll, U.S. Army Research Lab. (United States); S. Bayne, Texas Tech Univ. (United States)

POSTER SESSION

- 8377 0T **Solar-powered ad-hoc wireless sensor network for border surveillance** [8377-30]
J. He, R. A. Norwood, M. Fallahi, N. Peyghambarian, College of Optical Sciences, The Univ. of Arizona (United States)
- 8377 0U **DNA: multiple architectures for use in electronics applications** [8377-31]
T. J. Proctor, A. S. Finch, U.S. Army Research Lab. (United States)

Author Index

Conference Committee

Symposium Chair

Kevin P. Meiners, Office of the Secretary of Defense (United States)

Symposium Cochair

Kenneth R. Israel, Lockheed Martin Corporation (United States)

Conference Chairs

Nibir K. Dhar, Defense Advanced Research Projects
Agency/Microelectronics Technology Office (United States)
Priyalal S. Wijewarnasuriya, U.S. Army Research Laboratory
(United States)
Achyut Dutta, Banpil Photonics, Inc. (United States)

Program Committee

Pulickel M. Ajayan, Rice University (United States)
Palani Balaya, National University of Singapore (Singapore)
Deryn Chu, U.S. Army Research Laboratory (United States)
Angelo S. Gilmore, EPIR Technologies, Inc. (United States)
M. Saif Islam, University of California, Davis (United States)
Nobuhiko P. Kobayashi, University of California, Santa Cruz
(United States)
Pat McGrath, Booz Allen Hamilton Inc. (United States)
Robert Olah, Banpil Photonics, Inc. (United States)
A. Fred Semendy, U.S. Army Research Laboratory (United States)
Ashok K. Sood, Magnolia Optical Technologies, Inc. (United States)
Patrick J. Taylor, U.S. Army Research Laboratory (United States)
Sudhir B. Trivedi, Brimrose Corporation of America (United States)
Rama Venkatasubramanian, RTI International (United States)
Chunlei Wang, Florida International University (United States)

Session Chairs

- 1 Advanced Power and Energy Storage Technologies: Battery and Fuel Cells
Nibir K. Dhar, Defense Advanced Research Projects
Agency/Microelectronics Technology Office (United States)
Palani Balaya, National University of Singapore (Singapore)

- 2 Advanced Energy Storage Technologies: Battery and Fuel Cells I
 Nibir K. Dhar, Defense Advanced Research Projects
 Agency/Microelectronics Technology Office (United States)
 Achyut Dutta, Banpil Photonics, Inc. (United States)
- 3 Advanced Energy Storage Technologies: Battery and Fuel Cells II
 Palani Balaya, National University of Singapore (Singapore)
 Priyalal S. Wijewarnasuriya, U.S. Army Research Laboratory
 (United States)
- 4 Advanced Energy Harvesting Technologies
 Priyalal S. Wijewarnasuriya, U.S. Army Research Laboratory
 (United States)
 Palani Balaya, National University of Singapore (Singapore)
- 5 Advanced Energy Storage Technologies and Applications
 Nibir K. Dhar, Defense Advanced Research Projects
 Agency/Microelectronics Technology Office (United States)
 Achyut Dutta, Banpil Photonics, Inc. (United States)
- 6 Advanced Thermoelectric Energy Technologies I
 Rama Venkatasubramanian, RTI International (United States)
 Patrick J. Taylor, U.S. Army Research Laboratory (United States)
- 7 Advanced Thermoelectric Energy Technologies II
 Patrick J. Taylor, U.S. Army Research Laboratory (United States)
 Rama Venkatasubramanian, RTI International (United States)
- 8 Advanced Thermoelectric Energy Technologies III
 Rama Venkatasubramanian, RTI International (United States)
 Patrick J. Taylor, U.S. Army Research Laboratory (United States)
- 9 Advanced Thermoelectric Energy Technologies IV
 Chunlei Wang, Florida International University (United States)
 Palani Balaya, National University of Singapore (Singapore)