

# PROCEEDINGS OF SPIE

## *Nanoengineering: Fabrication, Properties, Optics, and Devices VIII*

Elizabeth A. Dobisz  
Louay A. Eldada  
*Editors*

23–24 August 2011  
San Diego, California, United States

*Sponsored by*  
SPIE

*Cosponsored by*  
Air Live (Taiwan)  
Fruhmann GmbH NTL Manufacturer & Wholesaler (Austria)

*Published by*  
SPIE

**Volume 8102**

Proceedings of SPIE, 0277-786X, v. 8102

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

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 *Nanoengineering: Fabrication, Properties, Optics, and Devices VIII*, edited by Elizabeth A. Dobisz, Louay A. Eldada, Proceedings of SPIE Vol. 8102 (SPIE, Bellingham, WA, 2011) Article CID Number.

ISSN 0277-786X  
ISBN 9780819487124

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 © 2011, 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](http://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/11/\$18.00.

Printed in the United States of America.

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



[SPIDigitalLibrary.org](http://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 | <i>Conference Committee</i> |
| ix  | Introduction                |

---

## SESSION 1 NANOPHOTONICS

---

- 8102 02 **Leaky-mode resonance photonics: an applications platform (Invited Paper)** [8102-01]  
R. Magnusson, The Univ. of Texas at Arlington (United States) and Resonant Sensors Inc. (United States); M. Shokooch-Saremi, The Univ. of Texas at Arlington (United States) and Ferdowsi Univ. of Mashhad (Iran, Islamic Republic of); K. J. Lee, J. Curzan, The Univ. of Texas at Arlington (United States); D. Wawro, S. Zimmerman, Resonant Sensors Inc. (United States); W. Wu, The Univ. of Texas at Arlington (United States); J. Yoon, The Univ. of Texas at Arlington (United States) and Hanyang Univ. (Korea, Republic of); H. G. Svavarsson, Reykjavik Univ. (Iceland); S. H. Song, Hanyang Univ. (Korea, Republic of)
- 8102 06 **Scattering optics resolve nanostructure (Keynote Paper)** [8102-05]  
J. Bertolotti, Univ. of Twente (Netherlands) and Univ. of Florence (Italy); E. G. van Putten, D. Akbulut, W. L. Vos, Univ. of Twente (Netherlands); A. Legendijk, Univ. of Twente (Netherlands) and FOM Institute for Atomic and Molecular Physics (Netherlands); A. P. Mosk, Univ. of Twente (Netherlands)

---

## SESSION 2 NANOENGINEERING FOR BIO-SENSORS

---

- 8102 07 **A photonic DNA processor: concept and implementation (Invited Paper)** [8102-06]  
T. Nishimura, Y. Ogura, K. Yamada, Osaka Univ. (Japan); H. Yamamoto, Univ. of Tokushima (Japan); J. Tanida, Osaka Univ. (Japan)
- 8102 08 **Threshold current calculations and optical cavity optimization for PbSe/PbSrSe multiple quantum well structures** [8102-07]  
M. Khodr, Hariri Canadian Univ. (Lebanon)
- 8102 09 **Sub-micron channels fabricated by direct electron beam lithography on SU8 for optofluidic bacterial analysis** [8102-08]  
A. E. Vasdekis, D. Psaltis, Ecole Polytechnique Fédérale de Lausanne (Switzerland)

---

## SESSION 3 NANOENGINEERING FOR SOLAR ENERGY

---

- 8102 0B **Nanotechnologies for efficient solar energy conversion and storage (Invited Paper)** [8102-10]  
L. Eldada, SunEdison (United States)
- 8102 0D **Optimization of the spray parameters for ZnO based hybrid solar cells** [8102-13]  
A. Vasudevan, S. Jung, T. Ji, Univ. of Arkansas (United States)

---

**SESSION 4 NANOENGINEERING FOR SENSORS**

---

- 8102 0F **Low temperature zinc oxide nanorod synthesis for gas detection applications** [8102-15]  
S. Jung, A. Vasudevan, M. Roddy, T. Ji, Univ. of Arkansas (United States)
- 8102 0G **UV detector from ZnO nanorods with electrodes resembling a wheatstone bridge pattern**  
[8102-16]  
A. Vasudevan, S. Jung, T. Ji, Univ. of Arkansas (United States)
- 8102 0H **Polyaniline nanofilms as a base for novel optical sensor structures** [8102-17]  
V. Vasinek, J. Bocheza, S. Hejduk, J. Latal, P. Koudelka, J. Vitasek, Technical Univ. of Ostrava  
(Czech Republic)

---

**SESSION 5 NOVEL NANODEVICES**

---

- 8102 0M **Light-emission from in-situ grown organic nanostructures** [8102-22]  
R. M. de Oliveira Hansen, J. Kjelstrup-Hansen, H.-G. Rubahn, Univ. of Southern Denmark  
(Denmark)
- 8102 0N **Deposition of sol-gel sensor spots by nanoimprint lithography and hemi-wicking** [8102-23]  
M. B. L. Mikkelsen, R. Marie, Technical Univ. of Denmark (Denmark); J. H. Hansen,  
H. O. Nielsen, DELTA (Denmark); A. Kristensen, Technical Univ. of Denmark (Denmark)
- 8102 0O **Design issue analysis for InAs nanowire tunnel FETs** [8102-24]  
S. S. Sylvia, Univ. of California, Riverside (United States); M. A. Khayer, Univ. of California,  
Riverside (United States) and Intel Corp. (United States); K. Alam, East West Univ.  
(Bangladesh); R. K. Lake, Univ. of California, Riverside (United States)
- 8102 0P **Carrier leakage in Ge/Si core-shell nanocrystals for lasers: core size and strain effects**  
[8102-25]  
M. R. Neupane, Univ. of California, Riverside (United States); R. Rahman, Sandia National  
Labs. (United States); R. K. Lake, Univ. of California, Riverside (United States)

---

**SESSION 6 NANOENGINEERING OF INTERFACES**

---

- 8102 0R **YAG:Ce nanoparticle based converter layer for white LEDs** [8102-33]  
A. Revaux, G. Dantelle, Lab. de Physique de la Matière Condensée, CNRS, Ecole  
Polytechnique (France); S. Brinkley, E. Matioli, Univ. of California, Santa Barbara (United  
States); C. Weisbuch, Univ. of California, Santa Barbara (United States) and Lab. de Physique  
de la Matière Condensée, CNRS, Ecole Polytechnique (France); J.-P. Boilot,  
T. Gacoin, Lab. de Physique de la Matière Condensée, CNRS, Ecole Polytechnique (France)
- 8102 0T **Exciton-polariton coupling and enhanced emission in SiC nanocrystals** [8102-29]  
G. Polupan, ESIME, National Polytechnic Institute (Mexico); M. Morales-Rodriguez, PCIM,  
Univ. Autónoma Metropolitana (Mexico)
- 8102 0V **Advanced holographic methods in extreme ultraviolet interference lithography** [8102-31]  
B. Terhalle, A. Langner, B. Päivänranta, Paul Scherrer Institut (Switzerland); Y. Ekinici,  
Paul Scherrer Institut (Switzerland) and ETH Zürich (Switzerland)

- 8102 0W **Fabrication of complex structures with an array of nanopinhole cameras** [8102-32]  
H. S. Leipner, Martin-Luther-Univ. Halle-Wittenberg (Germany); N. Geyer, Max-Planck-Institut für Mikrostrukturphysik (Germany); F. Syrowatka, H. Cheng, B. Fuhrmann, Martin-Luther-Univ. Halle-Wittenberg (Germany)

---

**SESSION 7 NANOSTRUCTURED MATERIALS**

---

- 8102 11 **Fabrication and optical characterization of nanopore Si** [8102-40]  
H. Jin, L. G. Liu, Univ. of Illinois at Urbana-Champaign (United States)
- 8102 13 **An alternative approach to fabricate metal nanoring structures based on nanosphere lithography** [8102-39]  
Z. A. Lewicka, W. W. Yu, V. L. Colvin, Rice Univ. (United States)

---

**POSTER SESSION**

---

- 8102 14 **Efficient approach for the calculation of transmission and reflection spectra of photonic crystal waveguide devices** [8102-41]  
R.-S. Chen, Y.-B. Lin, Lunghwa Univ. of Science and Technology (Taiwan)
- 8102 15 **Design of sharp waveguide bends with a wide high-transmission bandwidth in triangular photonic crystal slab** [8102-42]  
R.-S. Chen, Y.-J. Lin, Y.-B. Lin, Lunghwa Univ. of Science and Technology (Taiwan)
- 8102 16 **Nano and micro structures image based on asymmetric Bragg diffraction** [8102-43]  
A. V. Kuyumchyan, American NanoScience and Advanced Medical Equipment, Inc. (United States) and Institute of Microelectronics Technology (Russian Federation); V. Kohn, National Research Ctr. (Russian Federation); D. Kuyumchyan, California State Univ., Northridge (United States); A. Snigirev, I. Snigireva, European Synchrotron Radiation Facility (France); M. Grigorev, E. Shulakov, Institute of Microelectronics Technology and High Purity Materials (Russian Federation)
- 8102 17 **Fabrication of multiple Si nanohole thin films from bulk wafer by controlling metal-assisted etching direction** [8102-44]  
S.-C. Shiu, T.-C. Lin, K.-L. Pun, H.-J. Syu, S.-C. Hung, C.-F. Lin, National Taiwan Univ. (Taiwan)
- 8102 1A **Investigation of 0-3 composites for novel capacitors and energy storage** [8102-47]  
A. Buchsteiner, M. Zenkner, T. Großmann, C. Ehrhardt, M. Diestelhorst, S. Lemm, W. Münchgesang, C. Pientschke, J. Glenneberg, H. Beige, S. G. Ebbinghaus, H. S. Leipner, Martin-Luther-Univ. Halle-Wittenberg (Germany)
- 8102 1C **Control charge transfer in graphene by an electric field** [8102-27]  
R. Jalali, Islamic Azad Univ. (Iran, Islamic Republic of); E. Faizabadi, Iran Univ. of Science and Technology (Iran, Islamic Republic of)

*Author Index*



# Conference Committee

## *Symposium Chairs*

**David L. Andrews**, University of East Anglia Norwich (United Kingdom)  
**James G. Grote**, Air Force Research Laboratory (United States)

## *Conference Chairs*

**Elizabeth A. Dobisz**, Hitachi Global Storage Technologies, Inc. (United States)  
**Louay A. Eldada**, SunEdison (United States)

## *Program Committee*

**Andre-Jean Attias**, University Pierre et Marie Curie (France)  
**Gregory J. Exarhos**, Pacific Northwest National Laboratory (United States)  
**Cynthia Hanson**, Space and Naval Warfare Systems Ctr. Pacific (United States)  
**Ghassan E. Jabbour**, Arizona State University (United States)  
**Robert Magnusson**, The University of Texas at Arlington (United States)  
**Jun Tanida**, Osaka University (Japan)  
**Richard Tiberio**, Stanford University (United States)  
**Chee Wei Wong**, Columbia University (United States)

## *Session Chairs*

- 1 Nanophotonics  
**Louay A. Eldada**, SunEdison (United States)
- 2 Nanoengineering for Bio-Sensors  
**Alland P. Mosk**, University of Twente (Netherlands)
- 3 Nanoengineering for Solar Energy  
**Robert Magnusson**, The University of Texas at Arlington (United States)
- 4 Nanoengineering for Sensors  
**Andre-Jean Attias**, University Pierre et Marie Curie (France)
- 5 Novel Nanodevices  
**Elizabeth A. Dobisz**, Hitachi Global Storage Technologies, Inc. (United States)

- 6 Nanoengineering of Interfaces  
**Louay A. Eldada**, SunEdison (United States)
- 7 Nanostructured Materials  
**Elizabeth A. Dobisz**, Hitachi Global Storage Technologies, Inc.  
(United States)

## Introduction

This volume features contributions from scientists and engineers in the general area of nanoengineering. Over the past couple of years, mature technologies such as logic, memory, and data storage have been rapidly thrust into the sub-100 nm regime. Existing processes of record have been extended well beyond the ranges previously deemed feasible or reliable. New technologies such as advanced renewable energy harvesting systems, energy storage systems, biotechnology and medical nanosystems, 3D sensors, 3D displays, systems on a chip, optofluidics, nanophotonics, and molecular electronics and optics are emerging. The upcoming synthesized nanomaterials, nanocomposites, nanocoatings, nanoparticles, nanotubes and nanowires, offer extremely attractive novel physical properties with many opportunities. Continuing improvements in the design and fabrication of micro/nano/quantum-scale optical elements have driven the development of both passive and active miniature optical components with ever more diverse applications. New applications include optical communication, neural systems, optical information processing, optical computing, optical storage, optical scanning, smart pixel arrays, information display, imaging, printing, medical diagnosis, and chemical and biological sensing. Emerging nanotechnologies present new opportunities and challenges in materials processing, device design and integration. Commercial drivers are increased functionality, reduced size, performance, reliability, and cost.

The nanoengineering proceedings include discussions of novel material fabrication and processing, properties of nanostructures, innovative patterning and processing techniques, micro/nano/quantum optics, and fabrication and packaging of miniature devices. The innovations reflected in the papers range from driving existing schemes and processes to new limits to totally novel concepts and designs. Papers from academic and research institutions push the state of the art in miniaturization, level of integration, and performance figures of merit; papers from the industry require yield and tolerances as new design criteria, and nanofabrication manufacturing methods are exploited to make commercially deployed products.

Although this volume cannot include all the recent important work in the vast field of nanoengineering, it does cover a significant cross-section of the advances happening globally in areas where nanoengineering is making an impact. We hope these papers by world-renown experts serve the purpose of bringing the readers up to date on the state of the art in this fast-growing and exciting field.

**Elizabeth A. Dobisz**  
**Louay A. Eldada**

