

# PROCEEDINGS OF SPIE

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

**Eva M. Campo**  
**Elizabeth A. Dobisz**  
**Louay A. Eldada**  
*Editors*

**11–12 August 2015**  
**San Diego, California, United States**

*Sponsored and Published by*  
SPIE

**Volume 9556**

Proceedings of SPIE 0277-786X, V. 9556

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

Nanoengineering: Fabrication, Properties, Optics, and Devices XII, edited by  
Eva M. Campo, Elizabeth A. Dobisz, Louay A. Eldada, Proc. of SPIE Vol. 9556,  
955601 · © 2015 SPIE · CCC code: 0277-786X/15/\$18 · doi: 10.1117/12.2205183

Proc. of SPIE Vol. 9556 955601-1

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 *Nanoengineering: Fabrication, Properties, Optics, and Devices XII*, edited by Eva M. Campo, Elizabeth A. Dobisz, Louay A. Eldada, Proceedings of SPIE Vol. 9556 (SPIE, Bellingham, WA, 2015) Article CID Number.

ISSN: 0277-786X

ISBN: 9781628417227

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 © 2015, 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/15/\$18.00.

Printed in the United States of America.

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

**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. Papers are published as they are submitted and meet publication criteria. A unique 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

# Contents

- vii *Authors*
- ix *Conference Committee*
- xi *Nano-bio-optomechanics: nanoaperture tweezers probe single nanoparticles, proteins, and their interactions (Plenary Paper) [9544-501]*

---

## **SESSION 1 NANOFABRICATION FOR ENERGY HARVEST**

---

- 9556 02 **Technical requirements, manufacturing processes and cost efficiency for transparent electrodes based on silver nanowires and carbon nanotubes [9556-2]**
- 9556 04 **Invoking the frequency dependence in square modulated light intensity techniques for the measurement of electron time constants in dye-sensitized solar cells [9556-4]**

---

## **SESSION 2 NANOFABRICATION FOR NOVEL OPTICAL SURFACE PROPERTIES**

---

- 9556 06 **Ultra-slim coherent backlight unit for mobile holographic display (Invited Paper) [9556-6]**
- 9556 07 **Scalable nanostructuring on polymer by a SiC stamp: optical and wetting effects [9556-7]**

---

## **SESSION 3 NANOPHOTONICS**

---

- 9556 0A **Development of 3D photonic crystals using sol-gel process for high power laser applications [9556-10]**
- 9556 0E **PbSe/PbSrSe MQW characteristic temperature relationship with laser cavity length [9556-14]**

---

## **SESSION 4 MICRO, NANO, AND OPTICAL MATERIALS**

---

- 9556 0F **All-polymer based fabrication process for an all-polymer flexible and parallel optical interconnect [9556-16]**
- 9556 0G **Tolerance analysis of the pulse signal of a novel lateral deformable optical NEMS grating transducer [9556-17]**
- 9556 0H **Design of SiO<sub>x</sub> slab optical waveguides [9556-18]**
- 9556 0I **Design and fabrication of sinusoidal spectral filters for multispectral imaging [9556-19]**
- 9556 0J **Detection of coating fluorophores' densities in improved Q-factor cavities [9556-20]**

---

**SESSION 5 NANODEVICES**

---

- 9556 0M **Plasmonic structures fabricated via nanomasking sub-10 nm lithography technique** [9556-24]
- 9556 0N **Optomechanical nanoantenna: far-field control of near-field through mechanical reconfiguration** [9556-25]
- 9556 0O **Optimizing a sub-wavelength grating lens for large incidence angles** [9556-26]
- 9556 0P **Research on input shaping algorithm for rapid positioning of ultra-precision dual-stage** [9556-27]

---

**SESSION 6 NANOMETROLOGY AND PRECISION**

---

- 9556 0Q **Nanomanufacturing concerns about measurements made in the SEM part IV: charging and its mitigation (Invited Paper)** [9556-28]
- 9556 0T **Self-assembly based nanometer-scale patterning for nanowire growth** [9556-31]

---

**SESSION 7 NANOPATTERNING FOR SURFACE CHEMISTRY**

---

- 9556 0V **Linear and nonlinear optical processing of polymer matrix nanocomposites** [9556-33]
- 9556 0X **Nanoscale patterning of poly (L-lactic acid) films with nanoimprinting methods** [9556-35]

---

**SESSION 8 NANOMANUFACTURING AND METROLOGY**

---

- 9556 0Y **Nanomanufacturing-related programs at NSF (Invited Paper)** [9556-36]
- 9556 0Z **Challenges and needs for automating nano image processing for material characterization (Invited Paper)** [9556-37]
- 9556 10 **Scatterometry reference standards to improve tool matching and traceability in lithographical nanomanufacturing** [9556-38]
- 9556 12 **Laser velocimetry for measurement of non-sinusoidal vibration in sub-nanometer scale without lock-in amplifiers** [9556-40]

---

**POSTER SESSION**

---

- 9556 15 **Design and fabrication of multilayer dielectric gratings for spectral beam combining** [9556-43]
- 9556 16 **Advanced length scaling method of optical nanoantennas** [9556-44]
- 9556 17 **Design of optical channel waveguides in SiO<sub>2</sub> by ion implantation** [9556-45]

- 9556 19 **Nanoindentation for surface modification of nanofilms** [9556-47]
- 9556 1A **Optical properties of LEDs with patterned 1D photonic crystal** [9556-48]
- 9556 1B **The significance of the number of periods and period size in 2D photonic crystal waveguides** [9556-49]
- 9556 1C **Optical enhancement of photoluminescence with colloidal quantum dots** [9556-50]
- 9556 1F **Development of EUV scatterometer with high-harmonic-generation EUV source for nano-scale grating measurement** [9556-54]
- 9556 1H **Optical reflectivity as an inspection tool for metallic nanoparticles deposited randomly on a flat substrate** [9556-56]
- 9556 1I **Feasibility of sizing metallic nanoparticles in concentrated suspensions from effective optical properties** [9556-57]
- 9556 1J **Wafer defect inspection using component tree of SEM images** [9556-58]



# Authors

Numbers in the index correspond to the last two digits of the six-digit citation identifier (CID) article numbering system used in Proceedings of SPIE. The first four digits reflect the volume number. Base 36 numbering is employed for the last two digits and indicates the order of articles within the volume. Numbers start with 00, 01, 02, 03, 04, 05, 06, 07, 08, 09, 0A, 0B...0Z, followed by 10-1Z, 20-2Z, etc.

Abraham, Gabrielle, 1C  
Achenbach, S., 17  
Ackermann, Thomas, 02  
Agocs, Emil, 10  
Aldwayyana, Abdullah S., 04  
An, Jungkwuen, 06  
Argyraki, Aikaterini, 07  
Ashry, Islam, 0J  
Bai, Jian, 0G  
Bajwa, Pooja, 1C  
Barraza-Lopez, Salvador, 1B  
Bauman, Stephen J., 0M, 1B  
Bedja, Idriss M., 04  
Belleville, P., 0A  
Benčurová, A., 1A  
Benoit, F., 0A  
Bertussi, B., 0A  
Biswas, Rana, 0X  
Bodermann, Bernd, 10  
Böerner, M., 17  
Bonakdar, Alireza, 0N  
Borodin, Yuriy, 06  
Brown, Robert L., 0N  
Bukkapatnam, Satish T. S., 0Z  
Burger, Sven, 10  
Calles-Martínez, Alipio, 1H  
Chandramohan, Abhishek, 0T  
Chen, How-foo, 12  
Chen, Xinglin, 0P  
Chiang, Wei-Lun, 12  
Cho, Chia-Hung, 1F  
Cho, Hyun-Ju, 15  
Choi, Chil-Sung, 06  
Chung, Jae-Seung, 06  
Chung, U-in, 06  
Contreras-Tello, H., 1I  
Cooper, Khershed P., 0Y  
Daengngam, Chalongrat, 0J  
Dai, Gaoliang, 10  
De los Reyes, H., 17  
Debu, Desalegn T., 0M  
DeJournett, Travis J., 0V  
Dhakal, Rabin, 0X  
Dieudonné, E., 0A  
Ding, Yu, 0Z  
Dubinin, German, 06  
Dubrovskii, Vladimir G., 0T  
Dubynin, Sergey, 06  
Elsinger, Lukas, 0O  
Endres, Johannes, 10  
Enoch, S., 0A  
Fathipour, Vala, 0N  
French, David A., 1C  
Gallant, Andrew J., 0T  
García-Valenzuela, Augusto, 1H, 1I  
Ge, Tao, 0F  
Ghathian, Hamid M., 04  
Gordon, Reuven, xi  
Hadley, Peter, 0O  
Han, Karen, 0V  
Hansen, Poul-Erik, 10  
Haščik, Š., 1A  
Hassani Nia, Iman, 0N  
He, Ping, 0P  
Heidenreich, Sebastian, 10  
Herzog, Joseph B., 0M, 1B, 1C  
Heyes, Colin D., 1C  
Hezam, Mahmoud, 04  
Hirakawa, Keigo, 0I  
Hronec, P., 1A  
Hsieh, Yi-Chen, 1F  
Hwang, Sungwoo, 06  
Jang, Jae-Eun, 16  
Jang, Sung Jun, 0N  
Jia, Jie, 0I  
Kandas, Ishac, 0J  
Khodr, M., 0E  
Kim, Hojung, 06  
Kim, Hyun-Tae, 15  
Kim, Jaeyoun, 0X  
Kim, Minwoo, 1J  
Kim, Seunguk, 16  
Kim, Sun Il, 06  
Kim, Sunghyon, 1J  
Kolaric, Ivica, 02  
Kopenkin, Sergey, 06  
Koshelev, Alexander, 06  
Kováč, J., 1A  
Krumrey, Michael, 10  
Ku, Yi-Sha, 1F  
Kuzma, A., 1A  
Lee, Brennan, 0V  
Lee, Hong-Seok, 06  
Lee, Sung-Hoon, 06  
Lee, Yong-Soo, 15  
Lin, Rung-Fu, 12  
Lizarraga-Medina, E. G., 0H, 17  
Loechel, Bernd, 10

Lu, Weifang, 07  
 Luchenko, A. I., 19  
 Madsen, Morten Hannibal, 10  
 Mallejac, N., 0A  
 Márquez, Heriberto, 0H, 17  
 Márquez-Islas, R., 1I  
 Melnichenko, M. M., 19  
 Mendis, Budhika, 0T  
 Millett, Paul, 1B  
 Milster, Tom, 0F  
 Minixhofer, Rainer, 0O  
 Mishler, Jonathan, 1B  
 Mohseni, Hooman, 0N  
 Morales-Luna, Gesuri, 1H, 1I  
 Morozov, Alexander V., 06  
 Nemec, P., 1A  
 Ni, Chuan, 0I  
 Nielson, Lars, 10  
 Oh, Il-suk, 1J  
 Olassov, Lauren R., 0V  
 Oliver, A., 0H, 17  
 Ou, Haiyan, 07  
 Park, Joon-Yong, 06  
 Peer, Akshit, 0X  
 Petersen, Paul Michael, 07  
 Petty, Mike C., 0T  
 Postek, Michael T., 0Q  
 Probst, Juergen, 10  
 Putilin, Andrey, 06  
 Qaid, Saif M., 04  
 Rangel-Rojo, R., 17  
 Reyes-Coronado, Alejandro, 1H  
 Rezaei, Mohsen, 0N  
 Roth, Siegmund, 02  
 Sahakalkan, Serhat, 02  
 Salas-Montiel, R., 0H  
 Salazar, D., 17  
 Sanchez, C., 0A  
 Sarangan, Andrew, 0I  
 Sarollahi, Mirsaeid, 1B  
 Scholze, Frank, 10  
 Seo, Juwon, 06  
 Seo, Wontaek, 06  
 Shehata, Nader, 0J  
 Shin, Jeonghee, 16  
 Sibirev, Nikolai, 0T  
 Siddique, Muhemmad B., 04  
 Singulani, Anderson, 0O  
 Škriniarová, J., 1A  
 Soltwisch, Victor, 10  
 Song, Fazhi, 0P  
 Song, Hoon, 06  
 Spicer, James B., 0V  
 Summitt, Chris, 0F  
 Sung, Geeyoung, 06  
 Takashima, Yuzuru, 0F  
 Vallé, K., 0A  
 Vázquez, G. V., 0H, 17  
 Vázquez-Estrada, Omar, 1H, 1I  
 Vladár, Andrés E., 0Q  
 Wang, Chen, 0G  
 Wang, Kaiwei, 0G  
 Wang, Sunglin, 0F  
 Wang, Yan, 0P  
 Westkämper, Engelbert, 02  
 Wurm, Matthias, 10  
 Xu, Yong, 0J  
 Yang, Jilin, 0F  
 Yeh, Chia-Liang, 1F  
 Zeng, Fan W., 0V  
 Zeze, Dagou A., 0T

# Conference Committee

## *Symposium Chairs*

**Satoshi Kawata**, Osaka University (Japan)  
**Manijeh Razeghi**, Northwestern University (United States)

## *Symposium Co-chairs*

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

## *Conference Chairs*

**Eva M. Campo**, Bangor University (United Kingdom)  
**Elizabeth A. Dobisz**, Spin Transfer Technologies, Inc. (United States)  
**Louay A. Eldada**, Quanergy, Inc. (United States)

## *Conference Program Committee*

**André-Jean Attias**, Université Pierre-et-Marie-Curie (France)  
**Irene Fernandez-Cuesta**, Lawrence Berkeley National Laboratory  
(United States)  
**Sarah Haigh**, The University of Manchester (United Kingdom)  
**Sondra Hellstrom**, California Institute of Technology (United States)  
**Ghassan E. Jabbour**, Arizona State University (United States)  
**Robert Magnusson**, The University of Texas at Arlington (United States)  
**Ndubuisi George Orji**, National Institute of Standards and Technology  
(United States)  
**Balaji Panchapakesan**, Worcester Polytechnic Institute (United States)  
**Won Park**, University of Colorado at Boulder (United States)  
**Dorota A. Pawlak**, Institute of Electronic Materials Technology  
(Poland)  
**Michael T. Postek**, National Institute of Standards and Technology  
(United States)  
**Jun Tanida**, Osaka University (Japan)  
**Richard Tiberio**, Stanford University (United States)  
**Chee Wei Wong**, Columbia University (United States)

## *Session Chairs*

- 1 Nanofabrication for Energy Harvest  
**Eva M. Campo**, Bangor University (United Kingdom)

- 2 Nanofabrication for Novel Optical Surface Properties  
**Won Park**, University of Colorado at Boulder (United States)
- 3 Nanophotonics  
**Eva M. Campo**, Bangor University (United Kingdom)
- 4 Micro, Nano, and Optical Materials  
**Chee-Keong Tan**, Lehigh University (United States)
- 5 Nanodevices  
**Michael T. Postek**, National Institute of Standards and Technology  
(United States)
- 6 Nanometrology and Precision  
**Chee-Keong Tan**, Lehigh University (United States)
- 7 Nanopatterning for Surface Chemistry  
**André-Jean Attias**, Université Pierre-et-Marie-Curie (France)
- 8 Nanomanufacturing and Metrology  
**Michael T. Postek**, National Institute of Standards and Technology  
(United States)