PROCEEDINGS OF SPIE

Photonic and Phononic Properties of Engineered Nanostructures IV

Ali Adibi Shawn-Yu Lin Axel Scherer Editors

3–6 February 2014 San Francisco, California, United States

Sponsored and Published by SPIE

Volume 8994

Proceedings of SPIE 0277-786X, V. 8994

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

Photonic and Phononic Properties of Engineered Nanostructures IV, edited by Ali Adibi, Shawn-Yu Lin, Axel Scherer, Proc. of SPIE Vol. 8994, 899401 · © 2014 SPIE · CCC code: 0277-786X/14/\$18 · doi: 10.1117/12.2063212

Proc. of SPIE Vol. 8994 899401-1

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 Photonic and Phononic Properties of Engineered Nanostructures IV, edited by Ali Adibi, Shawn-Yu Lin, Axel Scherer, Proceedings of SPIE Vol. 8994 (SPIE, Bellingham, WA, 2014) Article CID Number.

ISSN: 0277-786X ISBN: 9780819499073

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 © 2014, 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/14/\$18.00.

Printed in the United States of America.

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



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

PHOTONIC CRYSTAL RESONATORS AND EMITTERS

- 8994 08 Enhanced transmission in photonic crystals microcavity filters in ridge-waveguide format
 [8994-7]

 A. S. Jugessur, The Univ. of Iowa (United States)
- High-performance photonic crystal membrane reflectors by magnetically guided metal-assisted chemical etching [8994-8]
 Y. Shuai, The Univ. of Texas at Arlington (United States); K. Balasundaram, P. K. Mohseni, Univ. of Illinois at Urbana-Champaign (United States); D. Zhao, The Univ. of Texas at Arlington (United States); H. Yang, Semerane, Inc. (United States); X. Li, Univ. of Illinois at Urbana-Champaign (United States); W. Zhou, The Univ. of Texas at Arlington (United States); W. Zhou, The Univ. of Texas at Arlington (United States); W. Zhou, The Univ. of Texas at Arlington (United States); W. Zhou, The Univ. of Texas at Arlington (United States); W. Zhou, The Univ. of Texas at Arlington (United States); W. Zhou, The Univ. of Texas at Arlington (United States); W. Zhou, The Univ. of Texas at Arlington (United States); W. Zhou, The Univ. of Texas at Arlington (United States); W. Zhou, The Univ. of Texas at Arlington (United States); W. Zhou, The Univ. of Texas at Arlington (United States); W. Zhou, The Univ. of Texas at Arlington (United States); W. Zhou, The Univ. of Texas at Arlington (United States); W. Zhou, The Univ. of Texas at Arlington (United States); W. Zhou, The Univ. of Texas at Arlington (United States); W. Zhou, The Univ. of Texas at Arlington (United States); W. Zhou, The Univ. of Texas at Arlington (United States); W. Zhou, The Univ. of Texas at Arlington (United States); W. Zhou, The Univ. of Texas at Arlington (United States); W. Zhou, The Univ. of Texas at Arlington (United States); W. Zhou, The Univ. of Texas at Arlington (United States); W. Zhou, The Univ. of Texas at Arlington (United States); W. Zhou, The Univ. of Texas at Arlington (United States); W. Zhou, The Univ. of Texas at Arlington (United States); W. Zhou, The Univ. of Texas at Arlington (United States); W. Zhou, The Univ. of Texas at Arlington (United States); W. Zhou, T

PHOTONIC CRYSTAL WAVEGUIDES AND FIBERS

- 8994 0B Transient dynamic distributed strain sensing using photonic crystal fibres [8994-10]
 S. A. Samad, G. M. Hegde, D. Roy Mahapatra, Indian Institute of Science (India);
 S. Hanagud, Georgia Institute of Technology (United States)
- 8994 OC Merged photonic crystal slot waveguide: confining slow modes in tiny volumes [8994-11] M. Roussey, A. Bera, P. Stenberg, S. Honkanen, M. Kuittinen, Univ. of Eastern Finland (Finland)

PHONONIC CRYSTALS, ACOUSTIC METAMATERIALS, AND OPTOMECHANICAL STRUCTURES

- 8994 OF Quasi-two-dimensional acoustic metamaterials (Invited Paper) [8994-14] D. Torrent, R. Graciá-Salgado, V. M. García-Chocano, F. Cervera, J. Sánchez-Dehesa, Univ. Politècnica de València (Spain)
 8994 OG Design and fabrication of a gradient-index phononic quartz plate lens (Invited Paper) [8994-15] T.-T. Wu, M. J. Chiou, National Taiwan Univ. (Taiwan); Y.-C. Lin, T. Ono, Tohoku Univ. (Japan)
- 8994 0H
 Funneled focusing of planar acoustic waves utilizing the metamaterial properties of an acoustic lens [8994-16]
 E. Walker, Univ. of North Texas (United States); D. Reyes, M. M. Rojas, Univ. Autónoma del Estado de México (Mexico); A. Krokhin, A. Neogi, Univ. of North Texas (United States)

GRAPHENE NANOPHOTONICS

8994 OP On-chip graphene optoelectronic devices for high-speed modulation and photodetection (Invited Paper) [8994-24] R.-J. Shiue, Massachusetts Institute of Technology (United States); X. Gan, Columbia Univ.

(United States); D. Englund, Massachusetts Institute of Technology (United States)

DESIGN AND CHARACTERIZATION OF PLASMONIC STRUCTURES

8994 0V Design optimization and fabrication of plasmonic nano sensor [8994-31]
 S. E. El-Zohary, The Univ. of Tokushima (Japan); A. Azzazi, The American Univ. in Cairo (Egypt); H. Okamoto, Anan National College of Technology (Japan); T. Okamoto, M. Haraguchi, Univ. of Tokushima (Japan); M. A. Swillam, The American Univ. in Cairo (Egypt)

NANOPLASMONIC STRUCTURES AND DEVICES

8994 0Y **CMOS-compatible metallic nanostructures for visible and infrared filtering** [8994-34] U. Palanchoke, S. Boutami, J. Hazart, CEA-LETI (France)

NOVEL PROPERTIES AND APPLICATION OF PLASMONIC STRUCTURES

8994 13 Cylindrical channel plasmon resonance for single-molecule sensing [8994-39]
 B. Terranova, A. A. Bellingham, S. Herbert, A. K. Fontecchio, Drexel Univ. (United States)

NANO-ANTENNA-BASED STRUCTURES FOR PHOTONIC APPLICATIONS

- 8994 16 Nano-antenna elements for controlling optical phase [8994-42] Y. Yifat, M. Eitan, Z. Iluz, A. Boag, Y. Hanein, J. Scheuer, Tel Aviv Univ. (Israel)
- Application of plasmonic subwavelength structuring to enhance infrared detection [8994-45]
 D. W. Peters, P. S. Davids, J. K. Kim, D. Leonhardt, T. E. Beechem III, S. W. Howell, T. Ohta, J. R. Wendt, J. A. Montoya, Sandia National Labs. (United States)

PHOTONIC METAMATERIALS

8994 1C Transmission in a 1D split-ring resonator metamaterial containing a nonlinear barrier: soliton modes [8994-48]
 A. R. McGurn, Western Michigan Univ. (United States)

8994 1D The negative refraction under out-of-plane incident condition: an experimental study [8994-49] S. Romano, F. De Tommasi, IMM, CNR, Univ. deali Studi di Napoli (Italy): A. C. De Luca, J.

S. Romano, E. De Tommasi, IMM, CNR, Univ. degli Studi di Napoli (Italy); A. C. De Luca, IBP, CNR (Italy); I. Rendina, IMM, CNR, Univ. degli Studi di Napoli (Italy); S. Cabrini, The Molecular Foundry, Lawrence Berkeley National Lab. (United States); V. Mocella, IMM, CNR, Univ. degli Studi di Napoli (Italy)

8994 1E ENZ waveguide of Al-doped zinc oxide for telecommunication applications [8994-50]
 H. Alisafaee, D. B. Fullager, M. A. Fiddy, The Univ. of North Carolina at Charlotte (United States)

OPTICAL PROPERTIES OF METASURFACES

8994 11 Stokes parameter sensor using an integrated cavity array metasurface [8994-54] I. Mandel, D. T. Crouse, The City College of New York (United States)

NOVEL PHENOMENA AND DEVICES IN PHOTONIC NANOSTRUCTURES I

- 8994 1K Near-infrared cut-off filters based on CMOS nanostructures for ambient light sensors and image sensors [8994-56]
 S. Junger, N. Verwaal, W. Tschekalinskij, N. Weber, Fraunhofer-Institut für Integrierte Schaltungen (Germany)
- 8994 1L Flexible optical-infrared metafilter [8994-57]
 J.-B. Brückner, Institut Materiaux Nanoelectronique de Provence, CNRS, Aix-Marseille Univ. (France) and Domaine Univ. de Saint-Jérôme (France); V. Brissonneau, CEA-Liten, DTNM (France); J. Le Rouzo, Institut Materiaux Nanoelectronique de Provence, CNRS, Aix-Marseille Univ. (France) and Domaine Univ. de Saint-Jérôme (France); A. Ferchichi, C. Gourgon, LTM, CNRS (France); C. Dubarry, CEA-Liten, DTNM (France); G. Berginc, Thales Optronique S.A. (France); L. Escoubas, Institut Materiaux Nanoelectronique de Provence, CNRS, Aix-Marseille Univ. (France) and Domaine Univ. de Saint-Jérôme (France)
- 8994 1M An all-dielectric broadband high-transmission efficiency circular polarizer [8994-58] A. S. Chadha, D. Zhao, W. Zhou, The Univ. of Texas at Arlington (United States)

NOVEL PHENOMENA AND DEVICES IN PHOTONIC NANOSTRUCTURES II

- 8994 10 Mechanical-free optical technology for nanostructures inspection [8994-60]
 M. V. Ryabko, S. N. Koptyaev, A. V. Shcherbakov, A. D. Lantsov, S. Oh, Samsung Advanced Institute of Technology (Russian Federation)
- A quantum tunneling theory for nanophotonics [8994-62]
 J. W. Haus, Univ. of Dayton (United States) and National Research Council AMRDEC (United States); D. de Ceglia, M. A. Vincenti, National Research Council AMRDEC (United States); M. Scalora, AMRDEC-RDECOM (United States)

8994 1R Fluorescence quenching metrology of graphene [8994-63]
 M. Ghazinejad, California State Univ., Fresno (United States); H. Hosseini Bay, J. Reiber Kyle, M. Ozkan, C. S. Ozkan, Univ. of California, Riverside (United States)

POSTER SESSION

- 8994 1S **Observing transverse Anderson localization in random air line based fiber** [8994-64] M. Chen, M.-J. Li, Corning Inc. (United States)
- 8994 11 Fabrication and evaluation of active spectral filter with metal-insulator-metal structure for visible light communication [8994-65]
 K. Murai, National Institute of Advanced Industrial Science and Technology (Japan);
 Y. Oshikane, F. Yamamoto, K. Hattori, Osaka Univ. (Japan); S. Mochizuki, T. Mihara, National Institute of Advanced Industrial Science and Technology (Japan); M. Nakano, Osaka Univ. (Japan)
- 8994 1U Efficient harmonic generation in double-near-zero-permittivity slabs [8994-66]
 M. A. Vincenti, D. de Ceglia, J. W. Haus, National Research Council AMRDEC (United States) and AMRDEC-RDECOM (United States); M. Scalora, Univ. of Dayton (United States)
- 8994 1W On the performance improvement of transmitted Bessel beams emitted from sub-wavelength annular aperture coupled with periodic grating [8994-68] C.-H. Weng, M.-H. Chung, C.-K. Lee, National Taiwan Univ. (Taiwan)
- 8994 1X Metallic nanoparticles arranged in a Helical geometry: Route towards strong and broadband chiro-optical response [8994-69]
 G. Nair, J. H. Singh, M. Venkatapathi, A. Ghosh, Indian Institute of Science (India)
- 8994 1Y Acousto-optic interaction induced photonic band gaps in silicon slab waveguides

 [8994-70]
 J.-C. Hsu, National Yunlin Univ. of Science and Technology (Taiwan); C.-H. Lin, J.-H. Shih, T.-R. Lin, National Taiwan Ocean Univ. (Taiwan)
- Anderson localized modes in a disordered glass optical fiber [8994-72]
 S. Karbasi, S. Hosseini, Univ. of Wisconsin-Milwaukee (United States); K. W. Koch, Corning Inc. (United States); T. Hawkins, J. Ballato, Clemson Univ. (United States); A. Mafi, Univ. of Wisconsin-Milwaukee (United States)
- 8994 21 Plasmonic emission enhancement from Er³⁺-doped tellurite glass via negative-nanobowtie [8994-73]
 V. A. G. Rivera, Univ. de São Paulo (Brazil); Y. Ledemi, Y. Messaddeq, Univ. Laval (Canada); E. Marega Jr., Univ. de São Paulo (Brazil)
- 8994 23 **High absorption thin-film absorber with gold nanorod arrays** [8994-75] G. Su, D. Xiao, C. Liu, F. Gou, Z. Zhang, Peking Univ. (China)

Author Index

Conference Committee

Symposium Chairs

David L. Andrews, University of East Anglia Norwich (United Kingdom) **Alexei L. Glebov**, OptiGrate Corporation (United States)

Symposium Co-chairs

Jean Emmanuel Broquin, IMEP-LAHC (France) Shibin Jiang, AdValue Photonics, Inc. (United States)

Program Track Chair

Ali Adibi, Georgia Institute of Technology (United States)

Conference Chairs

Ali Adibi, Georgia Institute of Technology (United States) Shawn-Yu Lin, Rensselaer Polytechnic Institute (United States) Axel Scherer, California Institute of Technology (United States)

Conference Program Committee

Andrea Alù, The University of Texas at Austin (United States)
William L. Barnes, University of Exeter (United Kingdom)
Ali Asghar Eftekhar, Georgia Institute of Technology (United States)
Reginald K. Lee, Orbits Lightwave, Inc. (United States)
Marko Loncar, Harvard School of Engineering and Applied Sciences (United States)
Susumu Noda, Kyoto University (Japan)
Masaya Notomi, NTT Basic Research Laboratories (Japan)
Ekmel Özbay, Bilkent University (Turkey)
Yong Xu, Virginia Polytechnic Institute and State University (United States)
Eli Yablonovitch, University of California, Berkeley (United States)
Rashid Zia, Brown University (United States)

Session Chairs

- 1 Recent Advances in Engineered Nanostructures Ali Adibi, Georgia Institute of Technology (United States)
- 2 Photonic Crystal Resonators and Emitters Axel Scherer, California Institute of Technology (United States)

- 3 Photonic Crystal Waveguides and Fibers Amr M. Baz, University of Maryland, College Park (United States)
- 5 Diamond Nanophotonics I: Joint Session with Conference 8997 Ali Adibi, Georgia Institute of Technology (United States)
- Diamond Nanophotonics II: Joint Session with Conference 8997
 Dirk R. Englund, Massachusetts Institute of Technology (United States)
- 7 Graphene Nanophotonics
 Marko Loncar, Harvard School of Engineering and Applied Sciences (United States)
- 8 Design and Characterization of Plasmonic Structures **Tony Low**, IBM Thomas J. Watson Research Center (United States)
- 9 Nanoplasmonic Structures and Devices
 John B. Pendry, Imperial College London (United Kingdom)
- 10 Novel Properties and Application of Plasmonic Structures Luca Dal Negro, Boston University (United States)
- 11 Nano-Antenna-based Structures for Photonic Applications Jennifer A. Dionne, Stanford University (United States)
- 12 Photonic Metamaterials Kenneth B. Crozier, Harvard University (United States)
- 13 Optical Properties of Metasurfaces Andrea Alù, The University of Texas at Austin (United States)
- 14 Novel Phenomena and Devices in Photonic Nanostructures I Shawn-Yu Lin, Rensselaer Polytechnic Institute (United States)
- 15 Novel Phenomena and Devices in Photonic Nanostructures II Shanhui Fan, Stanford University (United States)