Front Matter: Volume 9102
Terahertz Physics, Devices, and Systems VIII: Advanced Applications in Industry and Defense

Mehdi F. Anwar
Thomas W. Crowe
Tariq Manzur
Editors

5–6 May 2014
Baltimore, Maryland, United States

Sponsored and Published by
SPIE

Volume 9102
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:


ISSN: 0277-786X
ISBN: 9781628410396

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.

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

vii  Conference Committee

THZ IMAGING

9102 02  Image reconstruction method for non-synchronous THz signals [9102-1]
N. Oda, NEC Corp. (Japan); S. Okubo, Nippon Avionics Co., Ltd. (Japan); T. Sudou, NEC Corp. (Japan); G. Isoyama, R. Kato, A. Irizawa, K. Kawase, Osaka Univ. (Japan)

9102 03  Peculiarities of the detection and identification of substance at long distance [9102-2]
V. A. Trofimov, S. A. Varentsova, V. V. Trofimov, V. V. Tikhomirov, Lomonosov Moscow State Univ. (Russian Federation)

9102 05  Initial results of a real-time, quad-frequency, polarization-sensitive THz line camera [9102-4]
C. A. Roedig, D. J. Burdette, J. J. Law, Traycer Systems, Inc. (United States); G. C. Trichopoulos, K. Sertel, The Ohio State Univ. (United States); H. L. Mosbacker, Traycer Systems, Inc. (United States)

9102 06  3D THz range finder of concealed objects [9102-5]
J. Trontelj, A. Sešek, Univ. of Ljubljana (Slovenia); A. Švigelj, Letrika Lab. d.o.o. (Slovenia)

9102 07  Approaching real-time terahertz imaging using photo-induced reconfigurable aperture arrays [9102-6]
M. I. B. Shams, Z. Jiang, S. Rahman, J. Qayyum, Univ. of Notre Dame (United States); J. L. Hesler, Virginia Diodes, Inc. (United States); L.-J. Cheng, Oregon State Univ. (United States); H. G. Xing, P. Fay, L. Liu, Univ. of Notre Dame (United States)

THZ SOURCES I

9102 08  Microdisk resonators for difference frequency generation in THz range (Invited Paper) [9102-7]
R. Sinha, M. Karabiyik, C. Al-Amin, P. K. Vabbina, Florida International Univ. (United States); M. Shur, Rensselaer Polytechnic Institute (United States); N. Pala, Florida International Univ. (United States)

9102 0A  Dynamic lithography of v-shaped antennas for beam steering applications [9102-9]
T. Ali, A.-S. Popescu, The City College of New York (United States); I. Bendoym, Phoebus Optoelectronics (United States); S. Bikorimana, R. Dorsinville, The City College of New York (United States); L. Marchese, A. Bergeron, M. Terroux, INO (Canada); A. B. Golovin, D. T. Crouse, The City College of New York (United States) and Ctr. for Metamaterials (United States)
THZ DETECTION

9102 0C Comparison of terahertz technologies for detection and identification of explosives [9102-11]
R. Beigang, Technische Univ. Kaiserslautern (Germany); S. G. Biedron, Colorado State Univ. (United States); S. Dyjak, Military Univ. of Technology (Poland); F. Ellrich, Fraunhofer-Institut für Physikalik Kaleotechnik (Germany); M. W. Haakstad, Norwegian Defence Research Establishment (Norway); D. Hübsch, HÜBNER GmbH & Co. KG (Germany); T. Kartaloglu, E. Ozbay, Bilkent Univ. (Turkey); F. Ospald, Technische Univ. Kaiserslautern (Germany); N. Palka, Military Univ. of Technology (Poland); U. Puc, Jožef Stefan Institute (Slovenia); E. Czerwińska, Military Univ. of Technology (Poland); A. B. Şahin, Yıldırım Beyazıt Univ. (Turkey); A. Sešek, J. Trontelj, A. Švigelj, Univ. of Ljubljana (Slovenia); H. Altan, Middle East Technical Univ. (Turkey); A. D. van Rheenen, Norwegian Defence Research Establishment (Norway); M. Walczakowski, Military Univ. of Technology (Poland)

9102 0E High-resolution terahertz atmospheric water vapor continuum measurements [9102-13]
D. M. Slocum, T. M. Goyette, R. H. Giles, Univ. of Massachusetts Lowell (United States)

THZ SOURCES II

9102 0F Characterization of graphene-based devices for THz systems (Invited Paper) [9102-14]
C. Themistos, Frederick Univ. (Cyprus); B. M. A. Rahman, City Univ. London (United Kingdom); C. Markides, Frederick Univ. (Cyprus); M. Uthman, A. Quadir, City Univ. London (United Kingdom); N. Kejalakshmy, Frederick Univ. (Cyprus)

9102 0G Multiband terahertz quasi-optical balanced hot-electron mixers based on dual-polarization sinuous antennas [9102-15]
Z. Jiang, S. M. Rahman, S. T. Ruggiero, P. Fay, L. Liu, Univ. of Notre Dame (United States)

9102 0H Wideband 220 GHz solid state power amplifier MMIC within minimal die size [9102-16]
J. Cheron, E. N. Grossman, National Institute of Standards and Technology (United States)

NOVEL CONCEPTS AND APPLICATIONS I

9102 0I Giant terahertz gain by excitation of surface plasmon polarities in optically pumped graphene (Invited Paper) [9102-17]
T. Otsuji, T. Watanabe, S. B. Tombet, A. Satou, Tohoku Univ. (Japan); A. A. Dubinov, V. Y. Aleshkin, Lobachevsky State Univ. of Nizhny Novgorod (Russian Federation); V. Mitin, Univ. at Buffalo (United States); V. Ryzhii, Tohoku Univ (Japan)

9102 0J Exploiting plasmonics for THz and infrared sensing (Invited Paper) [9102-18]
S. M. Hanham, M. Navarro-Cia, B. Ng, H. Aouani, M. Rahmani, N. Klein, S. A. Maier, Imperial College London (United Kingdom)

9102 0K Dispersion studies in THz plasmonic devices with cavities [9102-19]
M. Karabiyik, R. Sinha, C. Al-Amin, Florida International Univ. (United States); G. C. Dyer, Sandia National Labs. (United States); N. Pala, Florida International Univ. (United States); M. S. Shur, Rensselaer Polytechnic Institute (United States)
Coherent phenomena in terahertz 2D plasmonic structures: strong coupling, plasmonic crystals, and induced transparency by coupling of localized modes (Invited Paper) [9102-20]  
G. C. Dyer, Sandia National Labs. (United States); G. R. Aizin, Kingsborough Community College (United States); S. J. Allen, Univ. of California, Santa Barbara (United States); A. D. Grine, D. Bethke, J. L. Reno, E. A. Shaner, Sandia National Labs. (United States)

KEYNOTE SESSION

Three-dimensional invisibility cloaks functioning at terahertz frequencies (Invited Paper) [9102-22]  
W. Cao, Oklahoma State Univ. (United States); F. Zhou, Northwestern Univ. (United States); D. Liang, Tianjin Univ. (China); J. Gu, Oklahoma State Univ. (United States) and Tianjin Univ. (China); J. Han, Tianjin Univ. (China); C. Sun, Northwestern Univ. (United States); W. Zhang, Oklahoma State Univ. (United States) and Tianjin Univ. (China)

NOVEL CONCEPTS AND APPLICATIONS II

T-ray detection in 0.35-µm CMOS technology [9102-24]  
G. J. Fertig, Z. Ninkov, Rochester Institute of Technology (United States); M. F. Bocko, J. Dayalu, Univ. of Rochester (United States); K. D. Fourspring, Exelis Geospatial Systems (United States); Z. Ignjatovic, Univ. of Rochester (United States); P. P. K. Lee, Univ. of Rochester (United States) and Exelis Geospatial Systems (United States); J. L. Pipher, Univ. of Rochester (United States); A. P. Sacco, Exelis Geospatial Systems (United States); C. Zhang, Rochester Institute of Technology (United States)

THz imaging Si MOSFET system design at 215 GHz [9102-25]  
A. P. Sacco, J. D. Newman, Exelis Geospatial Systems (United States); P. P. K. Lee, Exelis Geospatial Systems (United States) and Univ. of Rochester (United States); K. D. Fourspring, J. H. Osborn, R. D. Fiete, Exelis Geospatial Systems (United States); M. F. Bocko, Z. Ignjatovic, J. L. Pipher, C. W. McMurtry, X.-C. Zhang, J. Dayalu, Univ. of Rochester (United States); G. J. Fertig, C. Zhang, Z. Ninkov, Rochester Institute of Technology (United States)

Radar cross section measurements of frequency selective terahertz retroreflectors [9102-26]  
R. J. Williams, A. J. Gatesman, T. M. Goyette, R. H. Giles, Univ. of Massachusetts Lowell (United States)

POSTER SESSION

Multispectral concealed weapon detection in visible, infrared, and terahertz [9102-28]  
M. Kowalski, M. Kastek, H. Polakowski, N. Palka, M. Piszczek, M. Szustakowski, Military Univ. of Technology (Poland)
Advanced designs for non-imaging submillimeter-wave Winston cone concentrators

A. O. Nelson, NIST Boulder Labs. (United States) and Univ. of Colorado at Boulder (United States); E. N. Grossman, NIST Boulder Labs. (United States)

Author Index
Conference Committee

Symposium Chair

David A. Whelan, Boeing Defense, Space, and Security (United States)

Symposium Co-chair

Wolfgang Schade, Technische Universität Clausthal (Germany) and Fraunhofer Heinrich-Hertz-Institut (Germany)

Conference Chairs

Mehdi F. Anwar, University of Connecticut (United States)
Thomas W. Crowe, Virginia Diodes, Inc. (United States)
Tariq Manzur, Naval Undersea Warfare Center (United States)

Conference Program Committee

Giles Davies, University of Leeds (United Kingdom)
Gottfried H. Döhler, Max Planck Institute for the Science of Light (Germany)
Achyut K. Dutta, Banpil Photonics, Inc. (United States)
M. Saif Islam, University of California, Davis (United States)
Hiroshi Ito, Kitasato University (Japan)
Peter Uhd Jepsen, Technical University of Denmark (Denmark)
Edmund H. Linfield, University of Leeds (United Kingdom)
Amir Hamed Majedi, University of Waterloo (Canada)
Taiichi Otsuji, Tohoku University (Japan)
Nezih Pala, Florida International University (United States)
Azizur Rahman, City University London (United Kingdom)
Victor Ryzhii, University of Aizu (Japan)
Ashok K. Sood, Magnolia Optical Technologies, Inc. (United States)
Sigfrid K. Yngvesson, University of Massachusetts Amherst (United States)
Weili Zhang, Oklahoma State University (United States)

Session Chairs

THz Imaging
Tariq Manzur, Naval Undersea Warfare Center (United States)
Thomas W. Crowe, Virginia Diodes, Inc. (United States)
THz Sources I
Azizur Rahman, City University London (United Kingdom)
Mehdi F. Anwar, University of Connecticut (United States)

THz Detection
Nezih Pala, Florida International University (United States)

THz Sources II
Mehdi F. Anwar, University of Connecticut (United States)
Thomas W. Crowe, Virginia Diodes, Inc. (United States)

Novel Concepts and Applications I
Nezih Pala, Florida International University (United States)
Thomas W. Crowe, Virginia Diodes, Inc. (United States)

Keynote Session
Tariq Manzur, Naval Undersea Warfare Center (United States)
Thomas W. Crowe, Virginia Diodes, Inc. (United States)

Novel Concepts and Applications II
Mehdi F. Anwar, University of Connecticut (United States)
Nezih Pala, Florida International University (United States)