

PROCEEDINGS OF SPIE

Chemical and Biological Sensing VIII

Augustus W. Fountain III
Editor

11–12 April 2007
Orlando, Florida, USA

Sponsored and Published by
SPIE—The International Society for Optical Engineering

Volume 6554



The International Society
for Optical Engineering

Proceedings of SPIE—The International Society for Optical Engineering, 9780819466761, v. 6554

SPIE is an international technical society dedicated to advancing engineering and scientific applications of optical, photonic, imaging, electronic, and optoelectronic technologies.

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 *Chemical and Biological Sensing VIII*, edited by Augustus W. Fountain III, Proceedings of SPIE Vol. 6554 (SPIE, Bellingham, WA, 2007) Article CID Number.

ISSN 0277-786X
ISBN 9780819466761

Published by
SPIE—The International Society for Optical Engineering
P.O. Box 10, Bellingham, Washington 98227-0010 USA
Telephone 1 360/676-3290 (Pacific Time) · Fax 1 360/647-1445
<http://www.spie.org>

Copyright © 2007, The 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 <http://www.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/07/\$18.00.

Printed in the United States of America.

Contents

vii	<i>Conference Committee</i>
ix	<i>Introduction</i>

SESSION 1 SENSING CHEMICAL EXPLOSIVES

- 655403 **Micromachined microfluidic chemiluminescent system for explosives detection** [6554-02]
Y. Park, D. P. Neikirk, E. V. Anslyn, The Univ. of Texas at Austin (USA)
- 655404 **Landmine detection using passive hyperspectral imaging** [6554-03]
J. E. McFee, Defence R&D Canada Suffield (Canada); C. Anger, S. Achal, T. Ivanco, Itres Research Ltd. (Canada)
- 655405 **Stand-off Raman instrument for detection of bulk organic and inorganic compounds** [6554-04]
S. K. Sharma, A. K. Misra, P. G. Lucey, R. C. F. Lentz, C. H. Chio, Univ. of Hawaii at Manoa (USA)
- 655407 **Spectroscopic and design considerations for quartz-bound Au nanoparticle SERS substrates in chemical and biological detection** [6554-06]
W. N. Radicic, E. V. Ni, U.S. Military Academy (USA); A. W. Fountain III, U.S. Army RDECOM (USA)

SESSION 2 CHEMICAL DETECTION I

- 655408 **Field test results of standoff chemical detection using the FIRST** [6554-07]
T. S. Spisz, P. K. Murphy, C. C. Carter, A. K. Carr, Johns Hopkins Univ. Applied Physics Lab. (USA); A. Vallières, M. Chamberland, Telops, Inc. (Canada)
- 65540A **Wide-area hyperspectral chemical plume detection using parallel random sampling** [6554-09]
D. Rosario, Army Research Lab. (USA); J. Romano, Army Research, Development and Engineering Ctr. (USA)

Pagination: 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 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.

- 65540B **Detection of simulants and degradation products of chemical warfare agents by vibrational spectroscopy** [6554-10]
O. Ruiz-Pesante, L. C. Pacheco-Londoño, O. M. Primera-Pedrozo, W. Ortiz,
Y. M. Soto-Feliciano, D. E. Nieves, M. L. Ramirez, S. P. Hernández-Rivera, Univ. of Puerto Rico
Mayagüez (Puerto Rico)
- 65540C **New developments on standoff detection of explosive materials by differential reflectometry** [6554-11]
C. Schöllhorn, A. M. Fuller, J. Gratier, R. E. Hummel, Univ. of Florida (USA)

SESSION 3 CHEMICAL DETECTION II

- 65540D **Vibrational overtone stretching transitions in trimethyl phosphite and triethyl phosphite** [6554-12]
M. W. P. Petryk, Defence Research and Development Canada Suffield (Canada)
- 65540E **Operational characteristics of LWIR AOTF based multispectral imager** [6554-13]
N. B. Singh, M. Gottlieb, D. Suhre, D. Kahler, D. J. Knuteson, A. Berghmans, B. Wagner,
J. Hedrick, T. Karr, J. J. Hawkins, Northrop Grumman Corp. (USA)
- 65540F **Investigations of intraband quantum cascade laser source for a MEMS-scale photoacoustic sensor** [6554-14]
D. A. Heaps, P. M. Pellegrino, Army Research Lab. (USA)
- 65540G **Standoff detection using coherent backscattered spectroscopy** [6554-15]
A. W. Schill, Army Research Lab. (USA); B. R. Arnold, L. A. Kelly, Univ. of Maryland, Baltimore
County (USA); P. M. Pellegrino, Army Research Lab. (USA)
- 65540H **The feasibility of a nano-interial measurement unit that uses chemistry to record position** [6554-16]
M. E. Tanner, J. M. Protz, Duke Univ. (USA)

SESSION 4 BIOLOGICAL DETECTION I

- 65540I **Biological substance characterization in water matrices with Raman microspectroscopy** [6554-17]
R. E. Jabbour, A. Tripathi, Science Applications International Corp. (USA); P. J. Treado,
J. H. Neiss, M. P. Nelson, ChemImage Corp. (USA); J. L. Jensen, A. P. Snyder, Edgewood
Chemical Biological Ctr. (USA)
- 65540J **Detection and identification of a water mixture of *E. coli* cells and *B. subtilis* spores with Raman chemical imaging microscopy** [6554-18]
A. Tripathi, R. E. Jabbour, Science Applications International Corp. (USA); P. J. Treado,
J. H. Neiss, M. P. Nelson, ChemImage Corp. (USA); J. L. Jensen, A. P. Snyder, Edgewood
Chemical Biological Ctr. (USA)
- 65540K **Spectroscopic characterization of biological agents using FTIR, normal Raman, and surface-enhanced Raman spectroscopies** [6554-19]
T. Luna-Pineda, K. Soto-Feliciano, E. De La Cruz-Montoya, L. C. Pacheco Londoño,
C. Ríos-Velázquez, S. P. Hernández-Rivera, Univ. of Puerto Rico Mayagüez (Puerto Rico)

- 65540L **High sensitivity detection of bacteria by surface plasmon resonance enhanced common path interferometry** [6554-20]
C. Greef, V. Petropavlovskikh, O. Nilsen, B. Hacioglu, B. Khattatov, AlphaSniffer, LLC (USA); J. Hall, Hall Stable Lasers, LLC (USA)
- 65540M **A study of spore identification from diffraction data** [6554-21]
T. Le, Y. Cao, M. A. Fiddy, Univ. of North Carolina at Charlotte (USA); P. Gardner, Univ. of North Carolina at Charlotte (USA) and Detection Systems, General Dynamics Armament and Technical Products (USA)
- 65540N **Noninvasive forward-scattering system for rapid detection, characterization, and identification of bacterial colonies** [6554-22]
B. Rajwa, B. Bayraktar, P. P. Banada, K. Huff, E. Bae, E. D. Hirtleman, A. K. Bhunia, J. P. Robinson, Purdue Univ. (USA)
- 65540O **Compact chamber for the spectroscopic analysis of fluorescent aerosols** [6554-23]
B. Déry, Defence R&D Canada Valcartier (Canada) and Univ. Laval (Canada); J.-R. Simard, Defence R&D Canada Valcartier (Canada); R. Vallée, Univ. Laval (Canada); G. Roy, H. Lavoie, S. Buteau, Defence R&D Canada Valcartier (Canada)
- 65540P **Developments in on-the-fly biomarking: a new method to rapidly identify chemical and biological aerosols** [6554-24]
M. B. Hart, H.-B. Lin, J. Deich, C. D. Merritt, J. D. Eversole, Naval Research Lab. (USA)
- 65540Q **Extinction and backscatter cross sections of biological materials** [6554-25]
M. E. Thomas, M. B. Airola, C. C. Carter, N. T. Boggs, Johns Hopkins Univ. Applied Physics Lab. (USA)
- 65540R **Field testing results and ambient aerosol measurements using a dual-wavelength fluorescence excitation and elastic scatter for bio-aerosols** [6554-26]
V. Sivaprakasam, A. Huston, H. B. Lin, J. Eversole, P. Falkenstein, A. Schultz, Naval Research Lab. (USA)
- 65540S **Hyperspectral exploitation with plant sentinels** [6554-27]
A. K. Shaw, Gitam Technologies, Inc. (USA) and Wright State Univ. (USA); J. Medford, M. Antunes, Colorado State Univ. (USA); W. S. McCormick, Gitam Technologies, Inc. (USA) and Wright State Univ. (USA); D. Wicker, Air Force Research Lab. (USA)

SESSION 5 BIOLOGICAL DETECTION II

- 65540T **Spectrally resolved fluorescence cross sections of BG and BT with a 266-nm pump wavelength** [6554-28]
J. Atkins, M. E. Thomas, R. I. Joseph, Johns Hopkins Univ. (USA)
- 65540V **Detection and classification of atmospheric aerosols using multi-wavelength CO₂ lidar** [6554-30]
R. E. Warren, EO-Stat, Inc. (USA); R. G. Vanderbeek, U.S. Army Edgewood Chemical Biological Ctr. (USA)
- 65540W **Bayesian probabilistic approach for inverse source determination from limited and noisy chemical or biological sensor concentration measurements** [6554-31]
E. Yee, Defence R&D Canada Suffield (Canada)

65540Z **Investigation of synthetic molecular recognition for biosensing applications** [6554-34]
D. N. Stratis-Cullum, S. McMasters, L. J. Sooter, P. M. Pellegrino, Army Research Lab. (USA)

655410 **Recent testing and performance improvements of a fluorescence-based biological aerosol sensor** [6554-35]
B. K. Dable, G. A. Wilson, J. Brady, M. M. Carrabba, Hach Homeland Security Technologies (USA)

Author Index

Conference Committee

Symposium Chair

John C. Carrano, Luminex Corporation (USA)

Symposium Cochair

Larry B. Stotts, Defense Advanced Research Projects Agency (USA)

Program Track Chairs

John H. Holloway, Naval Surface Warfare Center Panama City (USA)

Patrick J. Gardner, General Dynamics Armament and Technical Products (USA) and University of North Carolina at Charlotte (USA)

Conference Chair

Augustus W. Fountain III, U.S. Army RDECOM ECBC (USA)

Program Committee

Jerome J. Braun, MIT Lincoln Laboratory (USA)

John C. Carrano, Luminex Corporation (USA)

Christopher C. Carter, Johns Hopkins Applied Physics Laboratory (USA)

Patrick J. Gardner, General Dynamics Armament and Technical Products (USA) and University of North Carolina at Charlotte (USA)

Matthew T. Griffin, General Dynamics Armament and Technical Products (USA)

Paul M. Pellegrino, Army Research Laboratory (USA)

Michael W. P. Petryk, Defence Research and Development Canada Suffield (Canada)

Cynthia R. Swim, U.S. Army Edgewood Chemical Biological Center (USA)

Session Chairs

- 1 Sensing Chemical Explosives
Augustus W. Fountain III, U.S. Army RDECOM ECBC (USA)
- 2 Chemical Detection I
Paul M. Pellegrino, Army Research Laboratory (USA)
- 3 Chemical Detection II
Christopher C. Carter, Johns Hopkins Applied Physics Laboratory (USA)

- 4 Biological Detection I
Jerome J. Braun, MIT Lincoln Laboratory (USA)
- 5 Biological Detection II
Michael W. P. Petryk, Defence Research and Development Canada
Suffield (Canada)

Introduction

This year we experienced the natural evolution of the conference by expanding our interest in chemical sensing of explosives in defense and security applications. The detection of explosives, as well as their precursor and residual chemicals, is a critical technology that allows us to identify threats and from where or whom they emanate. Further development of this technology will benefit not only our troops abroad, but our security and law enforcement forces at home.

Of particular interest to members of SPIE and attendees of this conference is that the underlying science and technology involved in sensing explosives and energetic chemicals is similarly applicable to the detection of chemical and biological warfare agents, toxic industrial chemicals or materials (TICs/TIMs), or other potential environmental hazards. Therein lies the strength and importance of the SPIE's Defense and Security Symposium. This symposium and particularly this conference provide an unprecedented forum for authors from government, industry, and academia to gather and address a wide variety of sensing issues and technologies. The authors presented in this conference represent nearly an equal one-third partition amongst those groups.

I want to take this time to particularly thank the members of the program committee for helping me plan, organize, and orchestrate this year's conference. They each work behind scenes all year long to make this conference not only possible, but truly a first-rate affair. Whether they come from government laboratories, industry, or academia they bring a tremendous amount of energy and professionalism to help me pull this conference off.

I learned a tremendous amount by reading and editing each of these papers, as well as attending each of their presentations. I hope that you, the reader, find value as well in these proceedings from this year's conference.

Augustus W. Fountain III