PROCEEDINGS OF SPIE

SPIDigitalLibrary.org/conference-proceedings-of-spie

Front Matter: Volume 6954

, "Front Matter: Volume 6954," Proc. SPIE 6954, Chemical, Biological, Radiological, Nuclear, and Explosives (CBRNE) Sensing IX, 695401 (6 May 2008); doi: 10.1117/12.800999

SPIE.

Event: SPIE Defense and Security Symposium, 2008, Orlando, Florida, United States

PROCEEDINGS OF SPIE

***Chemical, Biological,
Radiological, Nuclear, and
Explosives (CBRNE) Sensing IX***

**Augustus Way Fountain III
Patrick J. Gardner**
Editors

**18–20 March 2008
Orlando, Florida, USA**

Sponsored and Published by
SPIE

Volume 6954

Proceedings of SPIE, 0277-786X, v. 6954

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 *Chemical, Biological, Radiological, Nuclear, and Explosives (CBRNE) Sensing IX*, edited by Augustus Way Fountain III, Patrick J. Gardner, Proceedings of SPIE Vol. 6954 (SPIE, Bellingham, WA, 2008) Article CID Number.

ISSN 0277-786X

ISBN 9780819471451

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 © 2008, 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/08/\$18.00.

Printed in the United States of America.

Publication of record for individual papers is online in the 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 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
ix	Introduction

SESSION 1 EXPLOSIVES SENSING

- 6954 02 **Explosives signatures and analysis** [6954-01]
A. W. Fountain III, J. M. Oyler, S. A. Ostazeski, Edgewood Chemical Biological Ctr. (USA)
- 6954 03 **LIBS plasma enhancement for standoff detection applications** [6954-02]
D. K. Killinger, Univ. of South Florida (USA); S. D. Allen, Arkansas State Univ. (USA);
R. D. Waterbury, C. Stefano, E. L. Dottery, Alakai Inc. (USA)
- 6954 04 **Gamma-ray imaging for explosives detection** [6954-03]
G. A. de Nolfo, NASA Goddard Space Flight Ctr. (USA); S. D. Hunter, L. M. Barbier,
UMBC/CRESST/NASA (USA); J. T. Link, USRA/CRESST/NASA (USA); S. Son, NASA Goddard
Space Flight Ctr. (USA); S. R. Floyd, UMBC/CRESST/NASA (USA); N. Guardala, M. Skopec,
B. Stark, Naval Surface Warfare Ctr. (USA)
- 6954 05 **Combining hyperspectral imaging and Raman spectroscopy for remote chemical sensing**
[6954-04]
J. M. Ingram, U.S. Military Academy (USA); E. Lo, Susquehanna Univ. (USA)
- 6954 07 **Experimental demonstration of remote optical detection of trace explosives** [6954-06]
C. M. Wynn, S. Palmacci, R. R. Kunz, J. J. Zayhowski, B. Edwards, M. Rothschild, MIT Lincoln
Lab. (USA)
- 6954 08 **Characterization of near-infrared low energy ultra-short laser pulses for portable
applications of laser induced breakdown spectroscopy** [6954-07]
P. M. Pellegrino, A. W. Schill, D. N. Stratis-Cullum, U.S. Army Research Lab. (USA)
- 6954 09 **Standoff LIBS measurements of energetic materials using a 266nm excitation laser** [6954-08]
R. D. Waterbury, Alakai Consulting & Engineering Inc. (USA); A. Pal, D. K. Killinger, Univ. of
South Florida (USA); J. Rose, E. L. Dottery, G. Ontai, Alakai Consulting & Engineering Inc.
(USA)

SESSION 2 CHEMICAL SENSING I

- 6954 0C **Extending lifetime of plasmonic silver structures designed for high-resolution chemical
imaging or chemical and biological sensing** [6954-11]
C. A. Barrios, A. V. Malkovskiy, R. D. Hartschuh, A. M. Kisliuk, A. P. Sokolov, M. D. Foster, The
Univ. of Akron (USA)
- 6954 0D **Multidimensional molecular identification by laser control mass spectrometry** [6954-12]
M. Dantus, V. V. Lozovoy, X. Zhu, T. Gunaratne, Michigan State Univ. (USA)

- 6954 0E **Large area cold plasma applicator for decontamination** [6954-13]
G. A. Konesky, K-Plasma Ltd. (USA)
- 6954 0F **Recent advances toward a fiber optic sensor for nerve agent** [6954-14]
M. Beshay, S. R. Cordero, H. Mukamal, D. Ruiz, R. A. Lieberman, Intelligent Optical Systems, Inc. (USA)
- 6954 0G **Remote identification of liquid surface contamination by imaging Fourier transform spectrometry** [6954-15]
R. Harig, R. Braun, Hamburg Univ. of Technology (Germany); C. Dyer, C. Howle, B. Truscott, Defence Science and Technology Lab. (United Kingdom)
- 6954 0H **DMS-IMS2, GC-DMS, DMS-MS: DMS hybrid devices combining orthogonal principles of separation for challenging applications** [6954-16]
A. G. Anderson, K. A. Markoski, Q. Shi, S. L. Coy, E. V. Krylov, E. G. Nazarov, Sionex Corp. (USA)
- 6954 0I **A new miniature hand-held solar-blind reagentless standoff chemical, biological, and explosives (CBE) sensor** [6954-17]
W. F. Hug, Jet Propulsion Lab (USA); R. D. Reid, Photon Systems, Inc. (USA); R. Bhartia, A. L. Lane, Jet Propulsion Lab. (USA)
- 6954 0J **Fingerprinting CBRNE materials using surface-enhanced Raman scattering** [6954-18]
J. F. Bertone, K. M. Spencer, J. M. Sylvia, EIC Labs., Inc. (USA)
- 6954 0L **Active hyperspectral imaging system for the detection of liquids** [6954-46]
C. R. Howle, Defence Science and Technology Lab. (United Kingdom); D. J. M. Stothard, C. F. Rae, M. Ross, Univ. of St. Andrews (United Kingdom); B. S. Truscott, C. D. Dyer, Defence Science and Technology Lab. (United Kingdom); M. H. Dunn, Univ. of St. Andrews (United Kingdom)

SESSION 3 CHEMICAL SENSING II

- 6954 0M **Airborne measurements in the longwave infrared using an imaging hyperspectral sensor** [6954-20]
J.-P. Allard, M. Chamberland, V. Farley, F. Marcotte, M. Rolland, A. Vallières, A. Villemaire, Telops Inc. (Canada)
- 6954 0N **Imaging open-path Fourier transform infrared spectrometer for 3D cloud profiling** [6954-22]
J. Rentz Dupuis, D. J. Mansur, J. R. Engel, R. Vaillancourt, OPTRA, Inc. (USA); L. Todd, K. Mottus, Univ. of North Carolina, Chapel Hill (USA)
- 6954 0O **Acoustic system to slew chemical/biological sensor point of interest** [6954-23]
S. Desai, A. Morcos, M. Hohil, U.S. Army RDECOM (USA)
- 6954 0P **Detection of chemicals at a standoff >10 m distance based on single-beam coherent anti-Stokes Raman scattering** [6954-24]
M. Dantus, Michigan State Univ. (USA); H. Li, BioPhotonic Solutions Inc. (USA); D. A. Harris, B. Xu, P. J. Wrzesinski, V. V. Lozovoy, Michigan State Univ. (USA)

- 6954 0Q **CATSI EDM: recent advances in the development and validation of a ruggedized passive standoff CWA sensor** [6954-25]
H. Lavoie, J.-M. Thériault, F. Bouffard, E. Puckrin, C. S. Turcotte, Defence Research and Development Canada (Canada); P. Lacasse, Aerex Avionique Inc. (Canada)
- 6954 0R **Detection of gas plumes in cluttered environments using long-wave infrared hyperspectral sensors** [6954-26]
J. B. Broadwater, T. S. Spisz, A. K. Carr, The Johns Hopkins Univ. Applied Physics Lab. (USA)

SESSION 4 VENTURE CAPITAL CONSIDERATIONS FOR CBRNE

- 6954 0S **Chart Venture Partners' perspective on dual-use CBRNE technologies** [6954-27]
C. S. Van Nice, Chart Venture Partners (USA); P. J. Gardner, Western Carolina Univ. (USA)
- 6954 0T **In-Q-Tel, the strategic investment firm for the U.S. Intelligence Community** [6954-28]
S. J. Ulvick, D. W. Tighe, In-Q-Tel (USA)
- 6954 0U **Arch Venture Partners' investment considerations for CBRNE products and opportunities** [6954-29]
K. Crandell, S. Lazarus, ARCH Venture Partners (USA); P. J. Gardner, Western Carolina Univ. (USA)

SESSION 5 BIOLOGICAL SENSING I

- 6954 0V **Development of a standardized differential-reflective bioassay for microbial pathogens** [6954-30]
J. Wilhelm, J. R. X. Auld, J. E. Smith, West Virginia Univ. (USA)
- 6954 0W **Shape characteristics of biological spores** [6954-31]
D. V. Hahn, D. Limsui, R. I. Joseph, K. C. Baldwin, N. T. Boggs, A. K. Carr, C. C. Carter, T. S. Han, M. E. Thomas, The Johns Hopkins Univ. Applied Physics Lab. (USA)
- 6954 0X **Refractive index measurement of biological particles in visible region** [6954-32]
D. Limsui, A. K. Carr, M. E. Thomas, N. T. Boggs, R. I. Joseph, Johns Hopkins Univ. Applied Physics Lab. (USA)
- 6954 0Y **Extinction and backscatter cross sections of biological materials** [6954-33]
M. E. Thomas, D. V. Hahn, A. K. Carr, D. Limsui, C. C. Carter, N. T. Boggs, J. Jackman, Johns Hopkins Univ. Applied Physics Lab. (USA)
- 6954 0Z **Surface imaging microscope** [6954-34]
E. W. Rogala, I. N. Bankman, The Johns Hopkins Univ. Applied Physics Lab. (USA)

SESSION 6 BIOLOGICAL SENSING II

- 6954 10 **Short non-coding RNAs as bacteria species identifiers detected by surface plasmon resonance enhanced common path interferometry** [6954-35]
C. Greef, V. Petropavlovskikh, O. Nilsen, B. Khattatov, M. Plam, AlphaSniffer, LLC (USA); P. Gardner, Western Carolina Univ. (USA); J. Hall, Hall Stable Lasers LLC (USA)

- 6954 11 **DMS-prefiltered mass spectrometry for the detection of biomarkers** [6954-36]
S. L. Coy, E. V. Krylov, E. G. Nazarov, Sionex Corp. (USA)
- 6954 12 **Automated species and strain identification of bacteria in complex matrices using FTIR spectroscopy** [6954-37]
K. A. Puzey, QuantaSpec Inc. (USA); P. J. Gardner, Western Carolina Univ. (USA); V. K. Petrova, C. W. Donnelly, G. A. Petrucci, Univ. of Vermont (USA)
- 6954 13 **Classification of select category A and B bacteria by Fourier transform infrared spectroscopy** [6954-38]
A. C. Samuels, A. P. Snyder, Edgewood Chemical Biological Ctr. (USA); D. St. Amant, ITT Corp. (USA); D. K. Emge, Edgewood Chemical Biological Ctr. (USA); J. Minter, Science and Technology Corp. (USA); M. Campbell, U.S. Dept. of Agriculture (USA); A. Tripathi, Science Applications International Corp. (USA)

SESSION 7 RADIOLOGICAL AND NUCLEAR SENSING

- 6954 15 **Neutron imaging camera** [6954-40]
S. D. Hunter, NASA Goddard Space Flight Ctr. (USA); G. A. de Nolfo, UMBC/CRESST/NASA (USA); L. M. Barbier, NASA Goddard Space Flight Ctr. (USA); J. T. Link, USRA/CRESST/NASA (USA); S. Son, UMBC/CRESST/NASA (USA); S. R. Floyd, NASA Goddard Space Flight Ctr. (USA); N. Guardala, M. Skopec, B. Stark, Naval Surface Warfare Ctr. (USA)
- 6954 16 **Extraordinary improvement in scintillation detectors via post-processing with ASEDRA: solution to a 50-year-old problem** [6954-41]
E. LaVigne, G. Sjoden, J. Baciak, R. Detwiler, Univ. of Florida (USA)
- 6954 18 **Research and application of digital image processing technique in cobalt-60 based container inspection system** [6954-43]
B. Sun, Beijing Normal Univ. (China); Y. Liu, Beijing Energy Detection Technology Inc. (China); J. He, Beijing Normal Univ. (China)
- 6954 19 **A new electronic neutron dosimeter (END) for reliable personal dosimetry** [6954-44]
H. Ing, Bubble Technology Industries Inc. (Canada); T. Cousins, Defence Research and Development Canada (Canada); H. R. Andrews, R. Machrafi, A. Voevodskiy, V. Kovaltchouk, E. T. H. Clifford, M. Robins, Bubble Technology Industries Inc. (Canada); C. Larsson, R. Hugron, J. Brown, Defence Research and Development Canada (Canada)
- 6954 1A **Unattended sensors for nuclear threat detection** [6954-45]
R. C. Runkle, M. J. Myjak, M. T. Batdorf, R. S. Bowler, S. D. Kiff, S. J. Morris, C. A. Mullen, J. S. Rohrer, L. C. Todd, Pacific Northwest National Lab. (USA)

Author Index

Conference Committee

Symposium Chair

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

Symposium Cochair

Ray O. Johnson, Lockheed Martin Corporation (USA)

Program Track Chairs

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

Patrick J. Gardner, West Carolina University (USA)

Conference Chairs

Augustus Way Fountain III, U.S. Army Research, Development and
Engineering Command (USA)

Patrick J. Gardner, Western Carolina University (USA)

Program Committee

Jerome J. Braun, MIT Lincoln Laboratory (USA)

John C. Carrano, Luminex Corporation (USA)

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

Vernon T. Davis, National Nuclear Security Administration (USA)

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

Harry Ing, Bubble Technology Industries (Canada)

Harold R. McHugh, U.S. Department of Energy (USA)

Brian E. Moretti, U.S. Military Academy (USA)

Paul M. Pellegrino, Army Research Laboratory (USA)

Michael Peters, Intelagard, Inc. (USA)

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

Michael A. Strauss, General Dynamics Armament and Technical
Products (USA)

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

Session Chairs

- 1 Explosives Sensing
Augustus Way Fountain III, U.S. Army Research, Development and Engineering Command (USA)
- 2 Chemical Sensing I
Paul M. Pellegrino, Army Research Laboratory (USA)
- 3 Chemical Sensing II
Michael W. P. Petryk, Defence Research and Development Canada (Canada)
- 4 Venture Capital Considerations for CBRNE
Patrick J. Gardner, Western Carolina University (USA)
- 5 Biological Sensing I
Christopher C. Carter, The Johns Hopkins University Applied Physics Laboratory (USA)
- 6 Biological Sensing II
Jerome J. Braun, MIT Lincoln Laboratory (USA)
- 7 Radiological and Nuclear Sensing
Vernon T. Davis, National Nuclear Security Administration (USA)

Introduction

This year at the SPIE Defense and Security Symposium in Orlando, Florida, USA, we held our ninth annual conference for chemical and biological sensing, and due to a continuing interest in general threat detection, we expanded the 2008 conference to also include sensing of radiological, nuclear, and explosives materials. Over the last nine years, we have seen continuous advancement in capabilities for the detection and identification of threat agents. While agent sensitivity and selectivity continues to improve, system cost and complexity show downward movement.

Through the CBRNE Sensing Conference, we have seen exciting and promising technologies for point and standoff detection of CBRNE agents. For point detection, there are a variety of classical and emerging technologies, some of which promise affordability and reliability for combined CBE detection. For standoff detection, there are a small number of passive or active methods at infrared frequencies for chemical detection; however, standoff detection and identification of explosives and biological agents at operationally significant ranges continues to be a difficult problem to solve.

The strength and importance of the SPIE Defense and Security Symposium is that it provides an unprecedented international forum for authors from government, industry, and academia to gather and address a wide variety of sensing issues and technologies. The authors in these conference proceedings represent nearly an equal one-third partition among those groups and are leaders in each of their respective fields.

We want to take this time to particularly thank the members of the program committee for helping us 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 run this conference and make it successful.

We hope that each of you learn as much as we did by reading and editing each of these papers. Our hope is that you, the reader, will find value as well in the proceedings from this year's conference.

Augustus W. Fountain III
Patrick J. Gardner