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Next-Generation Spectroscopic Technologies X

Mark A. Druy
Richard A. Crocombe
Steven M. Barnett
Luisa T.M. Profeta
Editors

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Contents

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

SESSION 1	NOVEL LASER SPECTROSCOPY
10210 03	Versatile, ultra-low sample volume gas analyzer using a rapid, broad-tuning ECQCL and a hollow fiber gas cell [10210-2]
10210 04	Laser speckle reduction techniques for mid-infrared microscopy and stand-off spectroscopy [10210-3]
10210 06	Scanning, standoff TDLAS leak imaging and quantification [10210-5]
SESSION 2	NOVEL SPECTROMETERS I
10210 09	MIR hollow waveguide (HWG) isotope ratio analyzer for environmental applications [10210-8]
10210 0A	Wireless, battery-operated data acquisition system for mobile spectrometry applications and (potentially) for the Internet of things [10210-9]
SESSION 3	NOVEL SPECTROMETERS II
10210 0C	Thermal stabilization of static single-mirror Fourier transform spectrometers [10210-11]
10210 0H	Ultra-compact MEMS FTIR spectrometer [10210-15]
SESSION 4	NOVEL IMAGING INSTRUMENTATION
10210 0J	Time multiplexed spectral imaging of burning aluminum monoxide particles [10210-16]
10210 0K	A hyperspectral scanning microscope system for phenomenology support [10210-17]
10210 0L	Performance evaluation and modeling of a conformal filter (CF) based real-time standoff hazardous material detection sensor [10210-18]

- 10210 0N **Miniature infrared hyperspectral imaging sensor for airborne applications** [10210-20]
- 10210 0O **Push-broom imaging spectrometer based on planar lightwave circuit MZI array** [10210-21]

SESSION 5 SMARTPHONES, DATA FUSION AND RAMAN

- 10210 0S **Pharmaceutical applications using NIR technology in the cloud** [10210-24]
- 10210 0T **Embry-Riddle Aeronautical University multispectral sensor and data fusion laboratory: a model for distributed research and education** [10210-25]
- 10210 0U **Raman micro-spectroscopy as a non-destructive key analysis tool in current power semiconductor manufacturing** [10210-26]

SESSION 6 TERAHERTZ TECHNOLOGIES AND APPLICATIONS

- 10210 0W **Frequency-domain spectroscopy using high-power tunable THz-wave sources: towards THz sensing and detector sensitivity calibration (Invited Paper)** [10210-28]
- 10210 10 **THz spectroscopy of the atmosphere for climatology and meteorology applications** [10210-32]
- 10210 12 **Plasmonic enhanced terahertz time-domain spectroscopy system for identification of common explosives** [10210-34]

POSTER SESSION

- 10210 14 **Micro-Raman spectroscopy as a tool for the characterization of silicon carbide in power semiconductor material processing** [10210-37]

Authors

Numbers in the index correspond to the last two digits of the seven-digit citation identifier (CID) article numbering system used in Proceedings of SPIE. The first five 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.

Adib, George A., 0H	Li, Mingyu, 0O
Alharon, Mohamed H., 0H	Lucey, Paul G., 0K
Anwar, Momen, 0H	Makarem, Camille N., 03
Aubut, Nicholas F., 06	McCutchen, Earl, 0N
Bangalore, Arjun S., 0L	McGill, R. Andrew, 04
Bergmann, Ch., 0U	McMullen, Sonya A. H., 0T
Borges, Marco A., 0S	Medhat, Mostafa, 0H
Breshike, Christopher J., 04	Minamide, Hiroaki, 0W
Buehler, Stefan A., 10	Moran, James J., 03
Bütün, Bayram, 12	Nelson, Matthew P., 0L
Cerezuela-Barreto, M., 0U	Nguyen, Viet, 04
Christensen, Lance E., 03	Norman, Jessica, 0K
Coleman, Max L., 03	Özbay, Ekmel, 12
Crites, Sarah T., 0K	Phillips, Mark C., 03
Cruz-Cabrera, A. A., 0J	Roesner, M., 0U, 14
De Biasio, M., 0U, 14	Saadany, Bassam, 0H
Deev, Andrei, 09	Sabry, Yasser M., 0H
Demirağ, Yiğit, 12	Schardt, Michael, 0C
Demosthenous, B., 0J	Schellenberger, M., 0U
Dumont, Rich, 0H	Schultz, M., 14
Esteve, R., 0U, 14	Schwaller, Christian, 0C
Fitzgerald, Ryan, 0A	Sharp, L. J., 0J
Flatman, Ben, 10	Soos, J., 0J
Frish, Michael B., 06	Sternig, D., 14
Furstenberg, Robert, 04	Takida, Yuma, 0W
Geier, E., 0U	Tazik, Shawna K., 0L
Goller, B., 0U, 14	Temple, Dorota, 0L
Grossmann, Luiz, 0S	Treado, Patrick J., 0L
Hargrave, Peter, 10	Tremmel, Anton J., 0C
Hassan, Khaled, 0H	Trivedi, S. B., 0J
He, Jian-Jun, 0O	Wainner, Richard T., 06
Henderson, Troy, 0T	Wang, Zhenyou, 09
Hinnrichs, Bradford, 0N	Withington, Stafford, 10
Hinnrichs, Michele, 0N	Wu, Sheng, 09
Ison, David, 0T	Yang, Minyue, 0O
Jin, F., 0J	Zhuang, Yan, 09
Karanassios, Vassili, 0A	
Kasprzak, J., 0J	
Kelly, James F., 03	
Kendziora, Christopher A., 04	
Khalil, Diaa, 0H	
Klem, Ethan, 0L	
Kluft, Lukas, 10	
Koch, Alexander W., 0C	
Kraft, M., 0U, 14	
Kriesel, Jason M., 03	
Kumar Dongre, Prateek, 10	
Laderer, Matthew C., 06	
Lewke, D., 0U	

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Session Chairs

- 1 Novel Laser Spectroscopy
Leigh J. Bromley, Daylight Solutions Inc. (United States)
- 2 Novel Spectrometers I
Richard A. Crocombe, PerkinElmer, Inc. (United States)
- 3 Novel Spectrometers II
Richard A. Crocombe, PerkinElmer, Inc. (United States)

- 4 Novel Imaging Instrumentation
Steven M. Barnett, Barnett Technical Services, LLC (United States)
- 5 Smartphones, Data Fusion and Raman
Steven M. Barnett, Barnett Technical Services, LLC (United States)
- 6 Terahertz Technologies and Applications
Mark A. Druy, Galvanic Applied Sciences USA Inc. (United States)
Richard A. Crocombe, PerkinElmer, Inc. (United States)
Steven M. Barnett, Barnett Technical Services, LLC (United States)
Luisa T.M. Profeta, Field Forensics, Inc. (United States)

Introduction

The past twenty-five years have seen a massive investment in photonics, electronics, and MEMS aimed at developing new telecommunications capabilities and innovative consumer products. This has led to advances in miniature optics, light sources, tunable filters, array detectors, fiber optic sensors, and a range of other photonic devices across the whole electromagnetic spectrum, along with technologies for their mass production. Similarly, in recent years, there have been remarkable developments in handheld consumer electronics, especially mobile devices ("smartphones"). Today's devices contain advances in RF technology, processors, displays, operating systems, user interfaces, memory, Bluetooth, WiFi, GPS, cameras, accelerometers, etc. These technologies are increasingly being exploited in new spectroscopic instruments, and are now poised to be the basis of next-generation handheld scientific instruments.

Advances in array detectors (CCD, CID, InGaAs, InSb, SLS, MCT, CMOS, etc.) are enabling a new generation of faster imaging spectrometers with both laboratory and field applications. Lower-cost microbolometer infrared arrays have been developed, employing MEMS techniques. New laser-based sources (quantum cascade lasers, interband cascade lasers, supercontinua, terahertz, etc.), particularly in the mid-infrared, are being used in combination with advances in detector technology to create new spectroscopic platforms. Novel designs also enable very compact spectrometers and imagers, suitable for use on airborne platforms, including drones. The concurrent improvements in analytical theory, data analysis methods, algorithms, and the power of portable processors enable instrument designers to 'put a PhD scientist in the box' and empower field spectroscopic devices to give specific actionable answers.

Portable and handheld instruments tend to be more targeted at specific applications than their laboratory predecessors. They may have performance (measured as resolution, spectroscopic range, signal-to-noise, etc.) that is 'good enough' for field screening applications. However, they are often more selective, smaller, cheaper, more robust, and designed to give these actionable answers to non-scientist operators in the field. Spectroscopy-based systems are now making critical judgments in environments and applications that were unreachable twenty years ago, from hazardous materials to the operating theater, and from field geologists to customs and border personnel.

This conference focused on advanced technologies for spectroscopic instrumentation, particularly the UV-visible, infrared, near-infrared, and Raman molecular techniques, but also included advances enabling miniature and portable spectrometers across the electromagnetic spectrum, including x-ray fluorescence, laser induced fluorescence, laser induced breakdown

spectroscopy (LIBS), Terahertz, nuclear magnetic resonance, and mass spectrometry. The 2017 conference included special sessions on terahertz technologies and applications.

This conference premiered at Optics East 2007 in Boston, Massachusetts (United States), and it is now part of the Commercial + Scientific Sensing and Imaging Symposium within the DCS Meeting. The conference is now rotating between three sites, Baltimore, Maryland (United States), Anaheim, California (United States), and Orlando, Florida (United States); with the 2017 conference being in Anaheim. It spanned two days and was divided into sessions focused on: Novel Laser Spectroscopy; Novel Spectrometers; Novel Imaging Instrumentation; Smartphones, Data Fusion and Raman; Terahertz Technologies and Applications. The Conference Chairs believe that this Conference in 2015 had the first SPIE session devoted to "Smartphone Spectroscopy", and we anticipate that this will be a continuing and growing part of this Conference. In all, 40 papers were presented, 19 of which are included in this volume.

Mark A. Druy
Richard A. Crocombe
Steven M. Barnett
Luisa T.M. Profeta