## PROGRAM

The 2021 U.S. WORKSHOP on the PHYSICS and CHEMISTRY of II–VI MATERIALS

Embassy Suites Chicago Downtown – Lakefront
Chicago, Illinois, US
October 25–28, 2021

### II-VI Detector Materials
- IR
- UV
- Gamma-Ray
- X-Ray
- Photovoltaic
- CdZnTe
- HgCdTe
- ZnO
- ZnS
- History of IR Detectors

### Special Sessions
- Superlattices: II-VI and III-As/Sb
- II-VI Based Solar Cells
- Alternatives to CdZnTe Substrates
- HgCdTe Avalanche Photodiodes
- X-Ray and Gamma-Ray Detectors
- Surfaces and Interfaces
- ZnO Materials and Devices
- Defects and Doping
- Surface Passivation

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### Participating Organizations

- U.S. Army C5ISR Center Night Vision & Electronic Sensors Directorate
- U.S. Army Research Laboratory
- U.S. Army SMDC
- U.S. Navy Electro-Optics Center
- Penn State University
- Office of Naval Research
- Air Force Research Laboratory
- Army Research Office
- The Minerals, Metals & Materials Society

**Endorsed by**
The American Physical Society

http://www.ii-viworkshop.org
Promotional Partners and Exhibitors

The 2021 II-VI Workshop would like to express sincere thanks to our supporting organizations and for the contributions from our very generous corporate partners.

Gold Partners

- First Solar
- FHR
- Sivananthan Laboratories
- Episensors

Silver Partner

- 5N PLUS

Tabletop Exhibitor

- Pulse Instruments
Welcome

In the 40 years since the first MCT Workshop was held in 1981, the technology of HgCdTe and related devices has significantly matured and broadened. The Workshop plays a vital role in this technological evolution. It provides the principal open forum for the exchange of information relative to theory and experiment, synthesis, and analysis. It brings together university, governmental, and industrial research in a highly interactive manner.

- To encourage in-depth discussion and audience participation, the Workshop combines conventional oral and poster presentations with sufficient time allocated for questions and answers.
- To broaden exposure without sacrificing depth, invited speakers offer insight into areas relevant to II-VI materials.
- To ensure dissemination of results, submitted peer-reviewed full-length papers will appear in the *Journal of Electronic Materials*.

The Workshop will focus on fundamental research on the major scientific problems in II-VI materials. Its primary goal is to promote an understanding of the relationship among the physical and chemical properties and leverage this understanding into manufacturing and performance improvements.

Informal discussions among participants are strongly encouraged and ample time for paper discussion and individual interactions has been scheduled. To foster these interactions, lunch will be provided on all three days of the Workshop, and a Wine and Cheese Reception has been scheduled for Tuesday evening.

Don’t Miss the Solar Sessions

This year, we are pleased to offer three additional sessions dedicated to solar technology. These papers will be presented on Thursday, October 28.

Virtual Access

2021 II-VI attendees will have digital access to all Workshop content. Instructions for logging onto the online II-VI Workshop will be sent via email following the event.
The 2021 II-VI Workshop
Brings Together Industrial Leaders!

We are excited to announce this year’s invited speakers:

**Keynote Speaker:**
Craig Hoffman, *Naval Research Laboratory*
“The Naval Research Enterprise”

**Invited Speakers:**
Oğuz Altun, *ASELSAN Inc.*
“Progress in IR Technology at ASELSAN”

Philippe Ballet, *CEA-LETI*
“Advanced X-Ray Characterization and Imaging of IR”

Jim Beletic, *Teledyne Imaging Sensors*
“nBn/SLS FPA Progress”

Enrico Bellotti, *Boston University*
“Theoretical Study of the Vertical Carrier Transport in Strain Balanced Antimony-Based Superlattices”

David Benson, *NVESD*
“Analysis of HgCdTe/CdZnTe Defects”

Lorenzo Faraone, *University of Western Australia*
“Status and Future of IR Technology Research at UWA”

Heinrich Figgemeier, *AIM Infrarot-Module GmbH*
“Progress in FPA Technology at AIM”

Chad Fulk, *Raytheon Vision Systems*
“State of the Art and Future of HgCdTe Detectors at RVS”

Chung Han, *i3system, Inc.*
Paper title TBD

Pierre Jenouvrier, *LYNRED*
“Progress in FPA Technology at LYNRED”

Whitney Mason, *DARPA*
“Latest Efforts in EO/IR Imaging at DARPA”

Koji Murakami, *JX Nippon Mining & Metals Corporation*
“6 inch CdZnTe Crystal Growth and Characterization by JX”

Tony Ragucci, *Leonardo DRS*
“Sensing for Perception”

David Rhiger, *Raytheon Vision Systems*
“Current-Voltage Analysis of Dual-Band n-p-n HgCdTe Detectors”

Antoni Rogalski, *Military University of Technology*
“Whether 2d Materials Will Constitute the Real Competitors to LWIR HgCdTe HOT Photodiodes in the Future?”

Uptal Roy, *Savannah River National Laboratory*
“CdZnTeSe: An Emerging Material Toward Advancement of Radiation Detector and Substrate Applications”
David Ting, JPL
“nBn/SLS Technology”

James Wilson, Leonardo UK
“Current State of IR Detectors at Leonardo”

Tutorial:
Philip Klipstein, Semiconductor Devices
“III-V Barrier Detectors”

WORKSHOP CO-CHAIRS
Sivalingam Sivananthan, University of Illinois at Chicago (Proceedings Editor)
Scott Johnson, Raytheon Vision Systems
Daniel Lofgreen, Raytheon Vision Systems

PROGRAM COMMITTEE
Tony Almeida, U.S. Army CCDC C5ISR NVESD
Fikri Aquariden, Leonardo DRS (Electro-Optical & Infrared Systems)
Jose M. Arias, CACI / U.S. Army CCDC C5ISR NVESD
Enrico Bellotti, Boston University
Ishwara Bhat, Rensselaer Polytechnic Institute
Joseph Burns, Air Force Research Laboratory
Roger DeWames, MTEQ / U.S. Army C5ISR NVESD
Nibir Dhar, U.S. C5ISR Center NVESD (Proceedings Co-Editor and Web Site Manager)
Tim Gessert, National Renewable Energy Laboratory
Ralph James, Savannah River National Lab
Pradip Mitra, Leonardo DRS, Electro-Optical and Infrared Systems (EOIS)
Thomas Myers, Texas State University – San Marcos
Jill Nolde, Naval Research Laboratory
Joe Pellegrino, Army NVESD
Eric Piquette, Teledyne Imaging Sensors
Marion Reine, Consultant, Infrared Detectors
Priyalal Wijewarnasuriya, Teledyne Imaging Sensors
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WORKSHOP PARTICIPATING ORGANIZATIONS
U.S. Army CSISR Center Night Vision & Electronic Sensors Directorate
U.S. Army Research Laboratory
U.S. Army SMDC
U.S. Navy Electro-Optics Center
Penn State University
Office of Naval Research
Air Force Research Laboratory
Army Research Office
The Minerals, Metals & Materials Society

Endorsed by
The American Physical Society
WORKSHOP PARTICULARS

LOCATION AND DATE
The 2021 II-VI Workshop will be held from October 25–28 at the Embassy Suites Chicago, Magnificent Mile, Chicago, Illinois

WORKSHOP REGISTRATION
Registration for the 2021 II-VI Workshop can be accomplished in two ways:

1. By downloading the Registration Form located on the II-VI Workshop Web site (www.ii-viworkshop.org) and completing and sending it to:
   The 2021 II-VI Workshop
   Attn: Samantha Tola
   411 Lafayette St., Suite 201
   New York, NY 10003
   fax: (212) 460-5460; e-mail: stola@pcm411.com

2. By using the secure direct on-line link provided on the Workshop Website.

The deadline for advance registration is October 15, 2021. The fees include attendance at the technical sessions, lunches, refreshments, a copy of the Book of Extended Abstracts, and a copy of the Workshop Proceedings (printed soft-cover and electronic versions available). All checks must be payable in U.S. currency and be drawn from a U.S. bank and made payable to THE II-VI WORKSHOP. Refunds will not be issued after October 15, 2021.

<table>
<thead>
<tr>
<th>Registration Type</th>
<th>Advanced Registration Rate (Before October 15, 2021)</th>
<th>On-Site Registration Rate (After October 15, 2021)</th>
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<tbody>
<tr>
<td>Registration Fee w/Electronic Proceedings (Industrial, Government, or University)</td>
<td>$825.00</td>
<td>$895.00</td>
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<tr>
<td>Registration Fee w/Printed (Soft-Cover) Proceedings (Industrial, Government, or University)</td>
<td>$875.00</td>
<td>$915.00</td>
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<tr>
<td>Full-Time University Student or Retiree Fee w/Electronic Proceedings (Student ID Required)</td>
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<tr>
<td>Full-Time University Student or Retiree Fee w/Printed (Soft-Cover) Proceedings (Student ID Required)</td>
<td>$310.00</td>
<td>$310.00</td>
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</tbody>
</table>

For registration confirmation, please contact Palisades Convention Management, Inc., at 1-800-350-0111 or (813) 284-0634 or stola@pcm411.com.
TRAVEL ARRANGEMENTS
FROM THE AIRPORT

Chicago-O’Hare International Airport
Directions:
Take I-190 to I-90 East to Downtown. Exit Ohio Street. Hotel is on left corner of State and Ohio.
Distance from Hotel: 17 mi.
Limousine $70.00 USD Subway/Rail $7.50 USD
Taxi $50.00 USD Various other $30.00 USD

Chicago Midway Airport
Directions:
Cicero Ave. to I-55 North. I-55 North to I-90/94 West (Dan Ryan Expy). Exit Ohio Street. Hotel is on left corner of State and Ohio.
Distance from Hotel: 11 mi.
Limousine $60.00 USD Rental Car $50.00 USD
Subway/Rail $2.50 USD Taxi $40.00 USD
Various other $25.00 USD

For additional map and direction information visit:

WORKSHOP CHECK-IN

Attendees arriving on Monday, October 25, will be able to pick up their Workshop material at the II-VI Registration Desk located in the Lobby between 4:00 and 6:30 pm.
Please see the below registration hours throughout the week for attendees to pick-up their Workshop Materials at the II-VI Registration Desk:
Tuesday, October 26: 7:30 am–6:00 pm
Wednesday, October 27: 7:45 am–5:00 pm
Thursday, October 28: 8:00 am–3:00 pm

LUNCHES

Lunches will be served in a section of the hotel on all three days of the Workshop. To keep the Workshop on schedule, attendees are encouraged to participate.

WINE AND CHEESE/TABLETOP DISPLAYS

Following the presentations on Tuesday afternoon, a Wine and Cheese Reception has been scheduled to help promote informal discussion and attendee interaction. The Wine and Cheese Reception will be accompanied by several Tabletop Displays from commercial vendors displaying products of interest to the II-VI community. The tabletops will be on view during the Tuesday evening Reception as well as during the day on
Wednesday and Thursday in the Chicago River Ballroom Foyer. The poster session will also take place at the same time of the reception in a section of the Ballroom adjacent to the foyer.

**WORKSHOP MEETING ROOMS**

The Workshop presentations as well as the Poster Session on Tuesday will be held in the Chicago River Ballroom. The Wine and Cheese Reception, tabletop displays, and refreshment breaks will all take place in the Chicago River Ballroom Foyer.

**BOOK OF EXTENDED ABSTRACTS**

A copy of the *Book of Extended Abstracts* will be distributed to all attendees at the Workshop. The *Extended Abstracts* will contain summaries of all oral and poster papers presented at the Workshop.

**WORKSHOP PROCEEDINGS**

The II-VI Workshop papers will be published in a special issue of the *Journal of Electronic Materials*. The Proceedings will contain full-length refereed versions of papers presented at the Workshop. A copy of the Workshop Proceedings (printed soft-cover and electronic versions available) is included with the registration fees.

**INSTRUCTIONS TO AUTHORS PLANNING TO SUBMIT FULL-LENGTH MANUSCRIPTS**

We are asking all authors to submit their manuscripts to II-VI workshop for online peer review using the link provided by *Journal of Electronic Materials* (JEM) [http://www.editorial-manager.com/jems/](http://www.editorial-manager.com/jems/). Please click on “submit manuscript” at the top of the page. The online manuscript submission will close on December 17, 2021.

**II-VI Paper Submission**

- Authors (both oral and poster) who presented their work at the Workshop can submit their manuscripts either by going to the JEM’s editorial web page at [http://www.editorial-manager.com/jems/](http://www.editorial-manager.com/jems/) or via II-VI workshop’s website, [http://www.ii-viworkshop.org/](http://www.ii-viworkshop.org/). The link to the manuscript submission can be accessed by clicking on the Author’s Info link located under “About Workshop” link on the navigation banner on top of the II-VI Workshop’s website. Submissions via e-mail will not be accepted.
- New users will need to create an account. During the submission process, authors will be asked to enter additional information.
- The type of paper is “Special Issue” and the category is “2021 U.S. II-VI Workshop”.
- All submissions require an abstract of 200 words or less, a keywords line, a transfer of copyright form, and an electronic file. Papers are reviewed by two qualified referees to determine suitability. The editors’ decision to accept or reject a
paper, based on referees’ comments, is final. Please employ the following guidelines when submitting a paper for review:

- Manuscripts, written in English, should be in a single column and formatted to fit on a 22 × 28-cm sheet. Should manuscripts contain too many grammatical errors or awkward passages, the papers will be returned without review. Assistance of a professional proofreader (such as www.journalexperts.com) or qualified native speaker of English is recommended under these circumstances and may not only accelerate the review process but also allow for an early publication date.

- The title of the article and abstract should be separate from the text. References, figure captions, and tables should also be on separate pages.

- The works’ significance and its relation to the work of others should be detailed in the Introduction. Major assumptions should be stated and procedures adequately outlined.

- References should be cited by Arabic numbers as superscripts. Include the names of all authors, standard abbreviated name of journal (see, for example, http://library.caltech.edu/reference/abbreviations/) the volume number, initial page number, and year of publication in parenthesis. For books, include city of publication and publisher.

- Measurements should be given in metric units, including common abbreviations for time such as h, min, and s.

- Figures may be published online in color with no charge, but color figures in the print version of the Journal carry a mandatory fee.

To avoid delays, please:

1. Define all acronyms upon first use, including in the abstract, in this style: scanning electron microscopy (SEM).
2. All micrographs must have scale markers. All plots must have both axes labeled with the variable name (units).
3. Contact author e-mail address and keywords must be included on the abstract page.

For detailed guidelines on artwork and the copyright issue please visit:
http://www.springer.com/materials/optical+&+electronic+materials/journal/11664#

NOTE to ALL ATTENDEES: The 2021 Workshop content will be available online after the meeting.
PROGRAM

MONDAY, OCTOBER 25, 2021
4:00– 6:30 pm  Workshop Pre-Registration
5:00– 6:15 pm  Tutorial: Philip Klipstein

TUESDAY, OCTOBER 26, 2021
7:30– 6:00 pm  Registration
7:30– 9:30 am  Continental Breakfast
7:55– 8:00 am  Welcoming Remarks
8:00– 8:30 am  Keynote Address: Craig Hoffman
8:30–10:00 am 1: Industrial Overview I
10:00–10:15 am  BREAK
10:15–12:00 pm 2: Devices I
12:00– 1:15 pm  LUNCH
1:15– 3:30 pm  3: Avalanche Photodiodes
3:30– 3:45 pm  BREAK
3:45– 6:00 pm  4: Quantum Dots & Materials I
6:00– 7:30 pm  RECEPTION / TABLETOPS / WINE & CHEESE / POSTERS

WEDNESDAY, OCTOBER 27, 2021
7:45– 5:00 pm  Registration
7:30– 9:30 am  Continental Breakfast
7:55– 8:00 am  Welcoming Remarks
8:00– 8:30 am  Featured Presentation: Michael Eismann
8:30–10:00 am  5: Industrial Overview II
10:00–10:15 am  BREAK
10:15–12:00 pm  6: Heteroepitaxy
12:00– 1:15 pm  LUNCH
1:15– 2:15 pm  7: Industrial Overview III
2:15– 4:00 pm  8: Superlattice I and Devices II
4:15– 5:00 pm  9: Materials II
5:00– 6:00 pm  10: Devices III

THURSDAY, OCTOBER 28, 2021
8:00– 3:00 pm  Registration
7:30– 9:30 am  Continental Breakfast
7:55– 8:00 am  Welcoming Remarks
8:00– 9:15 am  11: Materials III
9:15– 9:30 am  BREAK
9:30–10:30 pm  12: Superlattice II and Devices III
10:30–10:45 pm  BREAK
10:45–12:15 pm  13: II-VI Solar Industry
12:15– 1:15 pm  LUNCH
1:15– 2:55 pm  14: Solar I
2:55– 3:15 pm  WILLIAM E. SPICER AND THOMAS N. CASSELMAN AWARDS
3:15– 5:00 pm  15: Solar II
MONDAY, OCTOBER 25, 2021
Chicago River Ballroom
(4:00 – 6:30 pm)

Workshop Pre-Registration (4:00–6:30)

Tutorial (5:00–6:15)

“III-V Barrier Detectors”
Philip Klipstein
Semiconductor Devices
Haifa, Israel

The 2021 II-VI Workshop will feature a tutorial section on Monday, October 25, on III-V Barrier Detectors. The tutorial welcomes all interested and registered II-VI workshop participants. The workshop committee particularly encourages graduate students, post-docs, and junior researchers to attend the tutorial.
TUESDAY, OCTOBER 26, 2021
Chicago River Ballroom
(7:30 am – 7:30 pm)

Registration (7:30–6:00)
Continental Breakfast (7:30–9:30)
Welcome Remarks (7:55–8:00)

II-VI Workshop Co-Chairs
Sivalingam Sivananthan
University of Illinois at Chicago
Scott Johnson
Raytheon Vision Systems
Daniel Lofgreen
Raytheon Vision Systems

KEYNOTE ADDRESS
8:00 – 8:30 am

Craig Hoffman
Naval Research Laboratory
“The Naval Research Enterprise”
Session 1: Industrial Overview I  
(8:30 – 10:00 am)

Chair:  
Dan Lofgreen  
Raytheon Vision Systems, US

Co-Chair:  
Sivalingam Sivananthan  
University of Illinois at Chicago, Chicago, IL, US

1.1 Invited Paper: Sensing for Perception  
(8:30)  
Tony Ragucci  
Leonardo DRS, Dallas, TX, US

1.2 Invited Paper: State of the Art and Future of HgCdTe Detectors at RVS  
(9:00)  
Chad Fulk  
Raytheon Vision Systems, Goleta, CA, US

1.3 Invited Paper: From Technology to Industrial Excellence at LYNRED  
(9:30)  
LYNRED, Veurey-Voroize, France  
O. Gravrand  
CEA-LETI, Grenoble, France

BREAK  
(10:00–10:15)
Session 2: Devices I
(10:15 am – 12:00 pm)

Chair: Jonathan Schuster
U.S. Army DEVCOM Army Research Laboratory (ARL), Adelphi, MD, US

2.1 Invited Paper: Current-Voltage Analysis of Dual-Band n-p-n HgCdTe Detectors
David Rhiger
Raytheon Vision Systems, Goleta, CA, US

2.2 Design of SWIR HgCdTe Detectors for High QE Applications
N. D. Akhavan, G. A. Umana-Membreno, R. Gu, J. Antoszewski, L. Faraone,
University of Western Australia, Crawley, Australia

2.3 150 mm Wafer Scale Manufacturing of HDVIP HgCdTe MWIR FPAs Operating at 140 K Grown by MBE with In-situ Passivation
John Armstrong, Christopher Schaake, Justin Wilks,Sameer Ajmera
Leonardo DRS, Dallas, TX, US
Jun Zhao, Fikri Aqariden
Leonardo DRS, Bolingbrook, IL, US

2.4 Performance of Very Long Wavelength Planar P+/n Devices
Priyalal Wijewarnasuriya, Bo Shojaei, John Gruenewald, Mitchell Dreiske, Jon Ellsworth, Annie Chen, Stephanie Tallarico, Kenneth Cante, Gernot Hildebrandt, Justin Eakins, Devraj Maitra, Aristo Yulius, Yibin Bai, Mike Carmody
Teledyne Imaging Sensors, Camarillo, CA, US

2.5 High Energy Neutron Irradiation Effects on HgCdTe and III-V Type II Superlattice Focal Plane Array
Yong Chang, Silviu Velicu, Sushant Sonde
EPIR, Inc., Bolingbrook, IL, US
Thomas Kroc
Fermi National Accelerator Laboratory, Batavia, IL, US

2.6 Student Paper: HgCdTe LWIR nBn Photodetectors Grown on Silicon Substrates
Ryan Sellers, Sivalingam Sivananthan
UIC Department of Physics, Chicago, IL, US
Also presented as poster session P.10

LUNCH (12:00–1:15)
Session 3: Avalanche Photodiodes
(1:15–3:30 pm)

Chair: Gregory Brill
DEVCOM Army Research Lab, Adelphi, MD, US

3.1 Invited Paper: Latest Efforts in EO/IR Imaging at DARPA
Whitney Mason
DARPA, US

3.2 Optimized High Gain 2-um Linear-Mode Avalanche Photodiode
Leye Aina, David Ramirez, Alex Harwit, William Painter, Brandon Hanold, Dave Shelton, Peter Kondratko
Ball Aerospace & Technology Corp, Boulder, CO, US
Joel Fastenau, Ying Wu, Scott Nelson, Dmitri Loubichev, Amy Liu
IQE, Inc., Bethlehem, PA, US

3.3 HgCdTe Avalanche Photodiodes for the 500–3300 nm spectral band operating at ≤240 K
Leonardo DRS, Dallas, TX, US
M. Zhu, I. Prigozhin, E. Bellotti
Boston University, Boston, MA, US

3.4 Student Paper: Modeling of Compositionally Graded HgCdTe Avalanche Photodiodes for Midwave and Shortwave Infrared Detection
M. Zhu, I. Prigozhin, E. Bellotti
Boston University, Boston, MA, US
Leonardo DRS, Dallas, TX, US
Also presented as poster session P.11.

3.5 Student Paper: Numerical Modeling of the Field-Aided HgCdTe APD for High Bandwidth Applications
Ilya Prigozhin, Enrico Bellotti
Boston University, Boston, MA, US
A. I. D’Souza
Leonardo DRS, Cypress, CA, US
Also presented as poster session P.12.

3.6 WITHDRAWN
3.7 Recent Advancements in HgCdTe APDs for Space Applications
Leonardo DRS, Dallas, TX, US
Xiaoli Sun
NASA Goddard Space Flight Center, Greenbelt, MD, US

3.8 Observation of Hole Multiplication in SWIR HgCdTe APDs
University of Grenoble Alpes, Grenoble, France

3.9 Student Paper: Metasurface-Coupled HgCdTe Avalanche Photodiodes – A Modeling Study
Prathmesh Deshmukh, C. H. Grein, P. Boieriu, S. Krishnamurthy
Sivananthan Laboratories, Bolingbrook, IL, US
J. C. Campbell
University of Virginia, Charlottesville, VA, US
Also presented as poster session P.13.

BREAK (3:30–3:45)
Session 4: Quantum Dots & Materials I
(3:45 – 6:00 pm)

Chair: Tony Almeida
NVESD, Fort Belvoir, VA, US

4.1 Invited Paper: Advanced X-Ray Characterization and Imaging of IR Materials (3:45)
Philippe Ballet
Université Grenoble Alpes, Grenoble, France

4.2 Carrier Recombination Lifetime Measurements of Semiconductor Wafers Using Optical Probing (4:15)
Yong Chang, Silviu Velicu, Sushant Sonde
EPIR Inc., Bolingbrook, IL, US

4.3 Defects Characterization of HgCdTe and CdZnTe Compounds by Positron Annihilation Spectroscopy (4:30)
Valentin Léger, Gilles Patriarche
C2N, Palaiseau, France
Pierre Desgardin, Jacques Botsoa, Marie-France Barthe
Institut Polytechnique de Paris, Palaiseau, France
Vincent Destefanis, Laurent Rubaldo
LYNRED, Veurey-Voroize, France
Catherine Corbel
CEMHTI-UPR3079 CNRS, Orléans, France

4.4 Student Paper: First Principles Study of Giant Stark Effect in 2D Materials (4:45)
Rathnayake Kandegeledara, Eranjan Rathnayake, Carlos A. Polanco, Zhi-Gang Yu
Sivananthan Laboratories, Inc., Bolingbrook, IL, US
Srini Krishnamurthy
Sivananthan Laboratories, Inc., Bolingbrook, IL, US and University of Illinois-Chicago, Chicago, IL, US

Also presented as poster session P.14.

4.5 Study of MBE LWIR HgCdTe Characteristics on CdZnTe Substrates of Closely Lattice-Matched Zn Concentrations (5:00)
Raytheon Vision Systems, Goleta, CA, US
J. D. Benson, B. Pinkie, J. A. Arias, A. E. Brown
4.6  A Library of Models for Computing HgCdTe Material Properties
Jamal I. Mustafa, David R. Rhiger, Chad W. Fulk
Raytheon Vision Systems, Goleta, CA, US

4.7  Investigation of Surfaces and Ligands for α-Sn Colloidal Quantum Dot Devices
R. M. E. B. Kandegedara, S. Sivananthan
University of Illinois at Chicago, Chicago, IL, US
P. T. Darancet
Argonne National Laboratory, Argonne, IL, US
S. Krishnamurthy, C. H. Grein
University of Illinois at Chicago, Chicago, IL, US and Sivananthan Laboratories, Bolingbrook, IL, US

4.8  Student Paper: Transport Measurements of Mercury Telluride Colloidal Quantum Dot Field Effect Transistors
Thomas Mlynarski, Richard Pimpinella
Sivananthan Laboratories, Inc., Bolingbrook, IL, US

Also presented as poster session P.15.

RECEPTION/TABLETOPS  (6:00–7:30)
Poster Sessions
(6:00 pm)

P.1
MOCVD and ALD Thin Film Growth Hardware and Coatings for IR Applications; Including: Antireflection, Transparent Conductors and Metalenses
G. S. Tompa, Arul Chakkaravarthi Arjunan, A. Feldman, L. Gary Provost, R. Moonsammy
Structured Materials Industries, Inc. (SMI), Piscataway, NJ, US

P.2
Electrical Characteristic of Ga-Free T2SL MWIR nBn Detector Based on InAs/AlAsSb/InAsSb Barrier
i3system, Inc., Daejeon, South Korea

P.3
Correlating Lateral and Vertical Electronic Transport Parameters in InAs/GaSb Type-II Superlattices
G. A. Umana-Membreno, N. D. Akhavan, J. Antoszewski, L. Faraone
University of Western Australia, Crawley, Australia

P.4
Update on Mid-Infrared HgTe Colloidal Quantum Dot PV Detectors
John Peterson, Haozhi Zhang, Philippe Guyot-Sionnest
University of Chicago, Chicago, IL, US

P.5
Production of CdZnTe Crystals Grown by THM Furnace in METU-CGL for Radiation Detection Applications
Mustafa Ünal, Özden Başar Balbaş, Mehmet Can Karaman, Ayşe Merve Ünal, Mehmet Parlık, Raşit Turan
Middle East Technical University, Ankara, Turkey

P.6
Suppression of Trapped Carriers of HgTe Colloidal Quantum Dots in a High-Frequency Photodetector System
Jungchul Noh, Brian Korgel
University of Texas at Austin, Austin, TX, US
Rich Pimpinella
Sivananthan Laboratories, Inc., Bolingbrook, IL, US

P.7
Optical Properties of Molecular Beam Epitaxy Grown Pb1-xSnxSe Films
Aofeng Bai, F. C. Peiris
Kenyon College, Gambier, OH, US
X. Liu, M. Dobrowolska, J. K. Furdyna
University of Notre Dame, Notre Dame, IN, US
P.9
Photodetectors Using Intra-Band Transitions in GeOx Cladded Ge Quantum Dot Superlattice (QDSL) for Mid-to-Long Infrared Range
F. Jain, R. Mays, R. H. Gudlavalleti, J. Chandy
University of Connecticut, Storrs, CT, US
E. Heller
Synopsys Inc., Ossining, NY, US

P.10
Student Poster: HgCdTe LWIR nBn Photodetectors Grown on Silicon Substrates
Ryan Sellers, Sivalingam Sivananthan
University of Illinois at Chicago, Chicago, IL, US
Also presented as oral session 2.6.

P.11
Student Poster: Modeling of Compositionally Graded HgCdTe Avalanche Photodiodes for Midwave and Shortwave Infrared Detection
M. Zhu, I. Prigozhin, E. Bellotti
Boston University, Boston, MA, US
P. Mitra, R. E. Scritchfield, C. A. Schaake, J. M. Martin,
J. D. Beck, P. D. Anderson, F. Aqariden, J. H. Park
Leonardo DRS, Dallas, TX, US
Also presented as oral session 3.4.

P.12
Student Poster: Numerical Modeling of the Field-Aided HgCdTe APD for High Bandwidth Applications
Ilya Prigozhin, Enrico Bellotti
Boston University, Boston, MA, US
A. I. D’Souza
Leonardo DRS, Cypress, CA, US
Also presented as oral session 3.5.

P.13
Student Poster: Metasurface-Coupled HgCdTe Avalanche Photodiodes – A Modeling Study
P. Deshmukh, C. H. Grein, P. Boieriu, S. Krishnamurthy
Sivananthan Laboratories, Bolingbrook, IL, US
J. C. Campbell
University of Virginia, Charlottesville, VA, US
Also presented as oral session 3.9.

P.14
Student Poster: First Principles Study of Giant Stark Effect in 2D Materials
Eranjan Rathnayake, Carlos A. Polanco, Zhi-Gang Yu
Sivananthan Laboratories, Inc., Bolingbrook, IL, US
Srini Krishnamurthy
Sivananthan Laboratories, Inc., Bolingbrook, IL, US and University of Illinois-Chicago, Chicago, IL, US
Also presented as oral session 4.4.
**P.15**

**Student Poster:** Transport Measurements of Mercury Telluride Colloidal Quantum Dot Field Effect Transistors  
Thomas Mlynarski, Richard Pimpinella  
Sivananthan Laboratories, Inc., Bolingbrook, IL, US  
*Also presented as oral session 4.8.*

**P.16**

**Student Poster:** First-Principles Study of the 30° Partial and 90° Partial Dislocations in HgTe, Hg_{0.7}Cd_{0.3}Te, and CdTe  
N. Hew, D. Spagnoli, L. Faraone  
University of Western Australia, Crawley, Australia  
*Also presented as oral session 6.3.*

**P.17**

**Student Poster:** Model and Characterization of Persistence on HgCdTe SWIR Imager  
T. Le Goff, O. Gravrand, N. Baier  
University of Grenoble Alpes, Grenoble, France  
T. Pichon, O. Boulade  
CEA – IRFU, Gif sur Yvette, France  
*Also presented as oral session 6.4.*

**P.18**

**Student Poster:** Photoluminescence Decay Signal Analysis of the Recombination Dynamics in Midwave Infrared HgCdTe  
M. Soria, P. Bleuet, A. Ferron, F. Boulard, J.-L. Santailler,  
S. Gout, B. Hoarau, J. Rothman  
University of Grenoble Alpes, Grenoble, France  
*Also presented as oral session 6.5.*

**P.19**

**Student Poster:** MBE Growth of High Quality HgCdSe on GaSb Substrate  
Zekai Zhang, Wenwu Pan, Wen Lei,  
Gilberto A. Umana-Membreno, Renjie Gu, Shuo Ma, Lorenzo Faraone  
University of Western Australia, Crawley, Australia  
*Also presented as oral session 6.6.*

**P.20**

**Student Poster:** Bandgap-Engineering of InGaAs/GaAsSb Superlattices Lattice-Matched to InP  
Armando Gil  
University of Michigan, Ann Arbor, MI, US  
Jamie Phillips  
University of Delaware, Newark, DE, US  
Martin Ettenberg  
*Also presented as oral session 8.4.*
P.21

Student Poster: II-VI Organic-Inorganic Hybrid Superlattices with Greatly Enhanced Optoelectronic Properties, Perfectly Ordered Structures and Unprecedented Long-Term Stability

Tang Ye, Margaret Kocherga, Damian Beasock, Andrei Nesmelov, Daniel S. Jones, Fan Zhang, Wanseok Oh, Yong Zhang, Thomas A. Schmedake
   University of North Carolina at Charlotte, Charlotte, NC, US

Yi-Yang Sun
   Chinese Academy of Sciences, Shanghai, China

Xiao-Ying Huang
   Rutgers University, Piscataway, NJ, US and Chinese Academy of Sciences, Fuzhou, China

Jing Li
   Rutgers University, Piscataway, NJ, US

Also presented as oral session 10.3.
Wednesday, October 27, 2021
Chicago River Ballroom
(7:45 am–5:00 pm)

Registration (7:45–5:00)
Continental Breakfast (7:30–9:30)
Welcome Remarks (7:55–8:00)

II-VI Workshop Co-Chairs
Sivalingam Sivananthan
University of Illinois at Chicago
Scott Johnson
Raytheon Vision Systems
Daniel Lofgreen
Raytheon Vision Systems

Featured Presentation (8:00-8:30)
Michael Eismann
AFRL

Session 5: Industrial Overview II
(8:30 –10:00 am)

Chair: Nibir Dhar
NVESD, Fort Belvoir, VA, US

5.1 Invited Paper: nBn/SLS FPA Progress (8:30)
Jim Beletic
Teledyne Imaging Sensors, US

5.2 Invited Paper (9:00)
Chung Han
i3systems, Inc., Mumbai, India

5.3 Invited Paper: Progress in FPA Technology at AIM (9:30)
Heinrich Figgemeier
AIM Infrarot-Module GmbH, Heilbronn, Germany

BREAK (10:00–10:15)
Session 6: Heteroepitaxy  
(10:15 am – 12:00 pm)

Chair: Enrico Bellotti  
Boston University, Boston, MA, US

6.1 Invited Paper: Status and Future Direction of IR Technology Research at UWA  
Lorenzo Faraone  
University of Western Australia, Perth, Australia

6.2 Multi-wafer Growth Simultaneously on Four 6 cm × 6 cm CdZnTe Substrates and CdZnTe Substrate Recovery Process for Step Increase in MBE HgCdTe Wafer Production  
Raytheon Vision Systems, Goleta, CA, US

6.3 Student Paper: First-Principles Study of the 30° Partial and 90° Partial Dislocations in HgTe, Hg0.7Cd0.3Te, and CdTe  
N. Hew, D. Spagnoli, L. Faraone  
University of Western Australia, Crawley, Australia  
Also presented as poster session P.16.

6.4 Student Paper: Model and Characterization of Persistence on HgCdTe SWIR Imager  
T. Le Goff, O. Gravrand, N. Baier  
University of Grenoble Alpes, Grenoble, France  
T. Pichon, O. Boulade  
CEA – IRFU, Gif sur Yvette, France  
Also presented as poster session P.17.

6.5 Student Paper: Photoluminescence Decay Signal Analysis of the Recombination Dynamics in Midwave Infrared HgCdTe  
University of Grenoble Alpes, Grenoble, France  
Also presented as poster session P.18.

6.6 Student Paper: MBE Growth of High Quality HgCdSe on GaSb Substrate  
Zekai Zhang, Wenwu Pan, Wen Lei, Gilberto. A. Umana-Membreno, Renjie Gu, Shuo Ma, Lorenzo Faraone  
University of Western Australia, Crawley, Australia  
Also presented as poster session P.19.

LUNCH  
(12:00–1:15)
Session 7: Industrial Overview III
(1:15–2:15 pm)

Chair: Jill Nolde,
      Naval Research Laboratory, US

7.1 Invited Paper: Current State of IR Detectors at Leonardo
J. Wilson, C. Maxey, I. Baker, K. Lake
Leonardo(UK), Southampton, UK

7.2 Invited Paper: Progress in IR Technology at ASELSAN
Oguz Altun
ASELSAN, Inc., Yanamahalle, Turkey
8.1 Invited Paper: nBn/SLS Technology
David Ting
JPL, US

8.2 Invited Paper: A Theoretical Study of the Vertical Carrier Transport in Strain Balanced Antimony-Based Superlattices
E. Bellotti
Boston University, Boston, MA, US
F. Bertazzi, A. Tibaldi
DET, Politecnico di Torino and IEIIT-CNR, Torino, Italy
J. Schuster, J. Bajaj, M. Reed
U.S. Army Combat Capabilities Development Command (CCDC), FCDD-RLS-ED, Adelphi, MD, US

8.3 Prediction of Shockley-Read-Hall Centers in Strained Layer Superlattices for Mid-Wave Infrared Photodetectors
Zhi-Gang Yu, S. Krishnamurthy
Sivananthan Laboratories, Bolingbrook, IL, US
Preston T. Webster, Christian P. Morath
Air Force Research Laboratory, Kirtland AFB, NM, US

8.4 Student Paper: Bandgap-Engineering of InGaAs/GaAsSb Superlattices Lattice-Matched to InP
Armando Gil
University of Michigan, Ann Arbor, MI, US
Jamie Phillips
University of Delaware, Newark, DE, US
Martin Ettenberg

Also presented as poster session P.20.

8.5 Assessing Sb-Cross Incorporation in InAs/InAsSb Superlattices
Zahira El Khalidi, Christoph H. Grein
University of Illinois at Chicago, Chicago, IL, US
Anthony Ciani
Sivananthan Laboratories, Bolingbrook, IL, US
Sivalingam Sivananthan
University of Illinois at Chicago, Chicago, IL, US and Sivananthan Laboratories, Bolingbrook, IL, US
8.6
XBn and XBp Detectors Based on Type II (3:45)
Superlattices
  SemiConductor Devices, Haifa, Israel
M. Katz, S. Schusterman, N. Sicron
  The Israel Center for Advanced Photonics, Yavne, Israel
I. Shafir
  Soreq NRC, Yavne, Israel
Session 9: Materials II  
(4:15–5:00 pm)

Chair: Fikri Aqariden  
DRS Electro-Optical & Infrared Systems (EOIS)

9.1 Invited Paper: 6-inch CdZnTe Crystal Growth and Characterization by JX  
K. Murakami  
JX Nippon Mining & Metals Corporation, Tokyo, Japan  
A. Noda, H. Kurita  
JX Nippon Mining & Metals Corporation, Ibaraki, Japan  
(4:15)

9.2 II-VI Materials Growth and Characterization at the WSU IMR  
John S. McCloy, Rubi Gul, Magesh Murugesan, Marc Weber, Santosh Swain, Saketh Kakkireni, Samuel Bigbee-Hansen  
Washington State University, Pullman, WA, US  
(4:45)
Session 10: Devices III  
(5:00 – 6:00 pm)

Chair: Dan Lofgreen  
Raytheon Vision Systems, US

10.1 Invited Paper: Whether 2D Materials Will (5:00)  
Constitute the Real Competitors to LWIR HgCdTe HOT Photodiodes in the Future?  
A. Rogalski  
Military University of Technology, Warsaw, Poland

10.2 Plasma Treatment for Surface Stabilization in (5:30)  
InAs/GaSb Type-II Superlattice LWIR and VLWIR Photodetectors  
H. J. Lee, Y. C. Kim, J. H. Eom, H. C. Jung, K. K. Kang,  
i3system, Inc., Daejeon, South Korea

10.3 Student Paper: II-VI Organic-Inorganic Hybrid (5:45)  
Superlattices with Greatly Enhanced Optoelectronic  
Properties, Perfectly Ordered Structures,  
and Unprecedented Long-Term Stability  
Tang Ye, Margaret Kocherga, Damian Beasock,  
Andrei Nesmelov, Daniel S. Jones, Fan Zhang, Wanseok Oh,  
Yong Zhang, Thomas A. Schmedake  
University of North Carolina at Charlotte, Charlotte, NC, US  
Yi-Yang Sun  
Chinese Academy of Sciences, Shanghai, China  
Xiao-Ying Huang  
Rutgers University, Piscataway, NJ, US and Chinese Academy of Sciences, Fuzhou, China  
Jing Li  
Rutgers University, Piscataway, NJ, US  
Also presented as poster session P.21.
THURSDAY, OCTOBER 28, 2021
Chicago River Ballroom
(8:00 am – 3:00 pm)

Registration (8:00–3:00)
Continental Breakfast (7:30–9:30)
Welcome Remarks (7:55–8:00)

II-VI Workshop Co-Chairs
Sivalingam Sivananthan
University of Illinois at Chicago
Scott Johnson
Raytheon Vision Systems
Daniel Lofgreen
Raytheon Vision Systems

Session 11: Materials III
(8:00 – 9:15 am)

Chair: Joseph Burns
Air Force Research Laboratory – AFRL/RXAN, Wright-Patterson AFB, OH, US

11.1 Invited Paper: Defect Analysis of HgCdTe (8:00)
David Benson
NVESD, Fort Belvoir, VA, US

11.2 RVS MBE Process for High Quality, High Throughput, Cost Effective, Substrate Size and Type Independent HgCdTe Wafer Production (8:30)
Raytheon Vision Systems, Goleta, CA, US

11.3 CdZnTe/CdTe Dislocation Filters for MBE Growth of CdTe Buffer Layers on GaAs (211)B Substrates (8:45)
W. Pan, R. Gu, Z. Zhang, W. Lei, G.A. Umana-Membreno, J. Antoszewski, L. Faraone
University of Western Australia, Crawley, Australia
D. J. Smith
Arizona State University, Tempe, AZ, US

11.4 Invited Paper: CdZnTeSe: An Emerging Material Towards Advancement of Radiation Detector and Substrate Applications (9:00)
Utpal Roy
Savannah River National Laboratory, Jackson, SC, US

BREAK (9:15–9:30)
Session 12: Superlattice II and Devices III
(9:30 – 10:30 am)

Chair: Priyalal Wijewarnasuriya
Teledyne Imaging Sensors, Camarillo, CA, US

12.1 Studies of Scattering Mechanisms in Multilayer HgCdTe Heterostructures
B. Shojaei, S. Wang, J. Gruenewald, J. Ellsworth, D. Edwall, A. Yulius, M. Carmody
Teledyne Scientific and Imaging, Camarillo, CA, US

12.2 Mid-Wavelength HgCdTe Infrared Detectors with Plasmon-Enhanced Performance
Marco Vallone, Giovanni Ghione
Politecnico di Torino, Torino, Italy
Alberto Tibaldi, Francesco Bertazzi, Michele Goano
Politecnico di Torino, Torino, Italy and CNR-IEIIT, Torino, Italy
Stefan Hanna, Anne Wegmann, Detlef Eich, Heinrich Figgeemeier
AIM INFRAROT-MODULE GmbH, Heilbronn, Germany

12.3 Infinite-Melt Vertical Liquid-Phase Epitaxy of HgCdTe from Hg Solution: From VLWIR to SWIR
Mauro F. Vilela, Jack Hogan, Brian T. Fennell, Gregory M. Venzor, Paul M. Goetz, Diane L. Baley, George Paloczi, Andreas Hampp
Raytheon Intelligence & Space – Raytheon Vision Systems, Goleta, CA, US

12.4 Optimizing Modified Direct Bond Interconnect Technology for IRFPA Hybridization
Sushant Sonde, Yong Chang, Suk-Ryong Hahn, Silviu Velicu
EPIR, Inc., Bolingbrook, IL, US
Kiran Sasikumar, Troy Loeffler
Argonne National Laboratory, Lemont, IL, US
Subramanian KRS Sankaranarayanan
Argonne National Laboratory, Lemont, IL, US and University of Illinois, Chicago, IL, US

BREAK
(10:30–10:45)
Session 13: II-VI Solar Industry  
(10:45 am – 12:15 pm)

Chair: Wyatt Metzger  
First Solar, Tempe, AZ, US

INTRODUCTION  
(10:45)

13.1  
First Solar Update  
Bill Huber  
First Solar, Tempe, AZ, US

13.2  
Transitioning CdTe to Existing and Emerging PV Markets: Technical Challenges in Traditional Rooftop and Rooftile Markets and Opportunities in Emerging BIPV and AIPV Markets  
Aaron Bates  
Toledo Solar, Perrysburg, OH, US

13.3  
Sustainable Development of High Performance II-VI Semiconductors  
Jean-Nicolas Beaudry  
5N Plus, Montreal, QC, Canada

13.4  
Pilkington PV Activities  
Kevin Sanderson  
Nippon Sheet Glass Co., Ltd, US

13.5  
Semitransparent CdTe for PV Windows: Ultrathin or Laser Ablated?  
Al Compaan  
Toledo Solar, Toledo, OH, US

13.6  
Thin Film Encapsulation and Reliability Developments  
Kurt Barth  
Direct Solar, US

13.7  
Electro-Optic Characterization Techniques for PV  
Greg Horner  
TauScience, Hillsboro, OH, US

13.8  
Solution Processed TCO Films: A Path to Low-Cost High-Performance Materials for CdTe Modules  
Cory Perkins  
NexTC, Corvallis, OR, US

LUNCH  
(12:15–1:15)
Session 14: Solar I
(1:15 – 2:55 pm)

Chair: Wyatt Metzger
First Solar, Tempe, AZ, US

14.1 Update on the CdTe PB R&D Landscape
Brion Bob and Inna Kozinsky
Department of Energy, Solar Energy Technology Office, US

14.2 Progress Towards Bifacial CdTe PV: Past, Present, and Future
Adam Phillips, Kamala Subedi, Dipendra Pokhrel, Aesha Patel, Manoj Jamarkattel, Gazi Quader, Prabodika Kaluarachchi, Andrei Los, Jailiu Ma, James Becker, Chungho Lee, Gang Xiong, Bill Huber, Ebin Bastola, Michael Heben, Randy Ellingson
University of Toledo, Toledo, OH, US

14.3 Back-Contact Evaluation: Key Measurements and Pitfalls
James R. Sites
Colorado State University, Fort Collins, CO, US

14.4 Low Dimensional Materials for Passivation in Successful PX Thin Film PV
Deborah L. McGott, Christopher P. Muzzillo, Craig L. Perkins, Joseph J. Berry, Kai Zhu, Joel N. Duenow, Eric Colegrove, Colin A. Wolden, Matthew O. Reese
National Renewable Energy Laboratory, US

14.5 N-Type CdTe for Photovoltaics
University of Liverpool, Liverpool, UK
S. Campbell, V. Barrioz
Northumbria University, Newcastle upon Tyne, UK

14.6 Void, Gas Bubble and Blister Formation in Sputtered Thin Film CdTe and CdSe
Michael Walls
Loughborough University, Loughborough, UK

14.7 Doped Emitters and the Pathway to 25% Efficient Solar Cells
Stuart Irvine
Swansea University, Swansea, Wales, UK
Investigating the Role of Copper in Arsenic Doped CdSeTe Photovoltaics

National Renewable Energy Laboratory, US
Session 15: Solar II
(3:15 – 5:00 pm)

Chair: Wyatt Metzger
First Solar, Tempe, AZ, US

15.1 Group-V Acceptor Ionization Energies and Compensation Centers in CdTe Revisited
Intuon Chatratin, Anderson Janotti
University of Delaware, Newark, DE, US

15.2 Advances in Lifetimes and Arsenic Doping in Cd(Se)Te Solar Cells
W. S. Sampath
Colorado State University, Fort Collins, CO, US

15.3 Multisource Deposition System for CdTe Photovoltaic Device Fabrication
Adam Phillips, Ebin Bastola, Griffin Barros-King, Zulkifl Hussain, Aesha Patel, Jared Friedl, Zhaoning Song, Abasi Abudulimu, Jacob Gibbs, Manoj Jamarkattel, Gazi Quader, Dipendra Pokhrel, Dengbing Li, Sandip Bista, Yanfa Yan, Randy Ellingson, Michael Heben
University of Toledo, Toledo, OH, US

15.4 TBD
Mariana Bertoni
Arizona State University, Tempe, AZ, US

15.5 Parsing Voltage Losses in CdSeTe Solar Cells: Drafting a Pathway to Reach Voc = 1 V
Arthur Onno
Arizona State University, Tempe, AZ, US

15.6 Characterizing Local Carrier Dynamics of CdTe Solar Cells Using Micro/Nanocontacts
Heayoung Yoon
University of Utah, Salt Lake City, UT, US

15.7 Multi-Mode Simulation of Cd(Se,Te) Devices
Marco Nardone
Bowling Green State University, Bowling, OH, US

Robert Klie
University of Illinois, Chicago, IL, US