PROCEEDINGS OF SPIE

Infrared Technology and Applications LI

Gabor F. Fulop Michael H. MacDougal David Z. Ting Masafumi Kimata Editors

14–17 April 2025 Orlando, Florida, United States

Sponsored and Published by SPIE

Volume 13469

Proceedings of SPIE 0277-786X, V. 13469

SPIE is an international society advancing an interdisciplinary approach to the science and application of light.

The papers 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. Additional papers and presentation recordings may be available online in the SPIE Digital Library at SPIEDigitalLibrary.org.

The papers 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 these proceedings: Author(s), "Title of Paper," in *Infrared Technology and Applications LI*, edited by Gabor F. Fulop, Michael H. MacDougal, David Z. Ting, Masafumi Kimata, Proc. of SPIE 13469, Seven-digit Article CID Number (DD/MM/YYYY); (DOI URL).

ISSN: 0277-786X ISSN: 1996-756X (electronic)

ISBN: 9781510687271 ISBN: 9781510687288 (electronic)

Published by **SPIE** P.O. Box 10, Bellingham, Washington 98227-0010 USA Telephone +1 360 676 3290 (Pacific Time) SPIE.org Copyright © 2025 Society of Photo-Optical Instrumentation Engineers (SPIE).

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 fees. To obtain permission to use and share articles in this volume, visit Copyright Clearance Center 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.

Printed in the United States of America by Curran Associates, Inc., under license from SPIE.

Publication of record for individual papers is online in the SPIE Digital Library.



Paper Numbering: A unique citation identifier (CID) number is assigned to each article in the Proceedings of SPIE at the time of 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 and print versions of the publication. SPIE uses a seven-digit CID article numbering system structured as follows:

• The first five 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.

Contents

ix Conference Committee

SHORTWAVE INFRARED I

- 13469 02 Extended shortwave infrared technological developments at Lynred [13469-2]
- 13469 04 Investigation of background doping and polarity in the unintentionally doped layer of PIN Ge0.91 Sn0.09 photodiodes on Si substrate [13469-5]

SHORTWAVE INFRARED II

13469 05	New SWIR product introduction from SUI [13469-6]
13469 06	SWIR product lines using small pixel pitch high-resolution focal plane arrays and advanced functionalities [13469-7]
13469 07	High-speed imaging at extended SWIR wavelengths using CQDs [13469-10]
13469 08	Progress in the development of quantum dots for SWIR image sensing applications [13469-75]
	AVALANCHE PHOTODIODES
13469 09	Progress at Leonardo UK in HOT APD array technology development for high-speed 2D linear mode photon counting applications [13469-11]
13469 OA	InGaAs-based devices for laser spot tracking and long-range remote sensing [13469-12]
13469 OB	Carrier transport using temperature dependent measurements in antimony-based avalanche photodiodes [13469-13]
	UNCOOLED
13469 OC	Microbolometer detector for multidomain battlespace [13469-14]

13469 0D How to reduce the memory effect in microbolometer cameras? [13469-15]

13469 OF	Uncooled 2100×2048 focal plane array for NASA sustainable land imaging technology
	sensor [13469-17]

- 13469 0G Electrical characteristics of Si_xGe_yO_{1-x-y} thin films by combinatorial approach [13469-18]
- 13469 OH Si-based LWIR metalens for 80×60 pixel uncooled IRFPA [13469-19]

III-V BULK AND TYPE-II SUPERLATTICE I

- 13469 0I Extended SWIR type-II superlattice detectors at IRnova (Invited Paper) [13469-20]
- 13469 0J HD detectors based on Type-II superlattices at ASELSAN [13469-21]
- 13469 OK Sparrow-HD HOT MWIR family for surveillance and MAWS applications [13469-22]

III-V BULK AND TYPE-II SUPERLATTICE II

- 13469 OL L3Harris advancements in large format type II superlattice FPA technology (Invited Paper) [13469-23]
- 13469 0M Strained layer superlattice focal plane array maturation for computational imaging applications (Invited Paper) [13469-24]
- 13469 ON T2SL and QWIP HD detectors at IRnova [13469-25]

INFRARED IN ASIA

13469 OQ	High-detectivity bolometer type uncooled longwave infrared detector using semi- conducting SWCNT networks in VGA formats [13469-28]
13469 OR	640x512 T2SL dual-band infrared detector and read-out circuit [13469-29]
13469 OS	Comparative study of digital and random alloy T2SLs on InP substrates [13469-30]
13469 OT	Graphene-InAs/GaInSb type-II superlattice-based infrared photodetectors [13469-31]

MCT/III-V FOCAL PLANE ARRAYS AND ROICS I

13469 0U Extraction of traps parameters in MWIR HgCdTe and T2SL using optical and electrical of a DI FPA [13469-32]

- 13469 OV Enabling access to low SWaP IR-modules for large format and long-wave FPAs [13469-33]
- 13469 0X Space-qualified technologies at Lynred [13469-35]
- 13469 OY Latest advancements in bandgap engineered MCT for HOT MW and low dark current arrays at Leonardo UK [13469-36]

MCT/III-V FOCAL PLANE ARRAYS AND ROICS II

- 13469 0Z Sub-10µm extended MWIR technologies development at Lynred (Invited Paper) [13469-37]
- 13469 10 Lynred's SWAP product lines using the high operating temperature technology [13469-38]
- 13469 11 MBE growth and characterization of III-Sb-based bulk alloy nBn infrared photodetector structures on 200mm substrates [13469-39]
- 13469 12 Surface passivation for InAs and InAs/InAsSb T2SL photodetectors [13469-40]
- 13469 13 New ROIC developments at SUI [13469-41]
- 13469 14 10µm pitch CTIA readout family for InGaAs and QD SWIR sensors [13469-42]

SYSTEMS

- 13469 16 Cross-domain few-shot object detection in infrared images using prompt tuning for vision and language models [13469-44]
- 13469 17 New Lynred engine solution for optical gas imaging: ATI EOLE [13469-45]
- 13469 18 Puddle depth estimation method for autonomous driving system on unpaved road [13469-46]

MACHINE LEARNING FOR INFRARED SENSING: JOINT SESSION WITH CONFERENCES 13463 AND 13469

13469 1A Multispectral optical zoom camera system using two fix-focus lenses [13469-48]

CRYOCOOLERS I

13469 1B Moving magnet actuator for ultra-low SWAP+C linear free piston compressor of Stirling type cryocooler [13469-50]

1040710	
13469 1D	Extended linear cryocooler development process: accelerating time-to-market and enhancing performance [13469-52]
13469 1E	Characterization of a linear piston compressor using a ring-down test [13469-53]

Illtra-low-SWAP chargeder for HOT IP detectors [13469.51]

13469 1F Standard mission profiles for Thales cooler reliability estimation [13469-54]

CRYOCOOLERS II

1316910

- 13469 1G RICOR's new generation of linear cryocoolers: reliability overview and development guidelines [13469-55]
- 13469 11 Cryocooler research at Imtek Cryogenics [13469-57]
- 13469 1J Coldfinger heat losses of miniature stirling cryocoolers [13469-58]

CRYOCOOLERS III

- 13469 1K High-efficiency microclass drive electronics for next-generation ultra-low SWaP cryocoolers [13469-59]
- 13469 1N Reliability approach for high-availability cryocoolers [13469-62]

SENSOR TECHNOLOGIES

- 13469 1R Sb₂Te₃-Bi₂Te₃ antenna-coupled thermoelectric THz detectors [13469-66]
- 13469 15 Visible light enhances the photoresponse of Si-based Schottky photodetectors in the MWIR region [13469-67]
- 13469 11 Resonant cavity enhancement of graphene-based Schottky barrier photodiodes [13469-68]

POSTER SESSION

- 13469 1U Basic study of wide dynamic range and antiblooming InGaAs detector for outdoor use case by linear-logarithmic response ROIC and potential barriered pixel (Invited Paper) [13469-69]
- 13469 1V Graphene-metagrating hybrid nanostructures for advanced functional infrared sensors [13469-70]

- 13469 1W Multifoci all-dielectric metalens for long-wavelength infrared [13469-71]
- 13469 1X Advanced software solutions for IR images [13469-72]
- 13469 1Y Adaptive decoy optimization in the long-wave [13469-73]