# PROCEEDINGS OF SPIE

# International Workshop on Thin Films for Electronics, Electro-Optics, Energy, and Sensors

Guru Subramanyam

Editor

4-6 July 2015 Suzhou, China

Organized by
University of Dayton (United States)
University of Dayton China Institute (China)
Nanjing University of Science & Technology (China)
Soochow University (China)

Published by SPIE

Volume 9667

Proceedings of SPIE 0277-786X, V. 9667

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

International Workshop on Thin Films for Electronics, Electro-Optics, Energy, and Sensors, edited by Guru Subramanyam, Proc. of SPIE Vol. 9667, 966701 ⋅ © 2015 SPIE CCC code: 0277-786X/15/\$18 ⋅ doi: 10.1117/12.2229403

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 International Workshop on Thin Films for Electronics, Electro-Optics, Energy, and Sensors, edited by Guru Subramanyam, Proceedings of SPIE Vol. 9667 (SPIE, Bellingham, WA, 2015) Six-digit Article CID Number.

ISSN: 0277-786X

ISSN: 1996-756X (electronic) ISBN: 9781628418866

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.ora

Copyright © 2015, 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/15/\$18.00.

Printed in the United States of America.

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



**Paper Numbering:** Proceedings of SPIE follow an e-First publication model. A unique citation identifier (CID) number is assigned to each article 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 six-digit CID article numbering system structured as follows:

- 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.

# Contents

V	<b>Authors</b>	
V	Autilois	

vii Conference Committee

ix Introduction

#### PRESENTED PAPERS

9667 02	Light emission in silicon: from device physics to applications (Invited Paper) [9667-27]
9667 03	Optical tuning of electrical properties of PZT thin film deposited on STO [9667-30]
9667 04	Thin film barium strontium titanate ferroelectric varactors for microwave applications [9667-43]
9667 05	A resonant circuit realization using a 3D inductor in combination with thin film varactor technology [9667-42]
9667 06	Nanostructured zinc oxide thin film for application to surface plasmon resonance based cholesterol biosensor [9667-29]
9667 07	Direct metal transfer printing on flexible substrate for fabricating optics functional devices [9667-23]
9667 08	Wavefront reconstruction using smartphone based wavefront sensors [9667-12]
9667 09	Steerable beaming of photons with angular momentum using nano-emitter-coupled plasmonic structure (Invited Paper) [9667-14]
9667 0A	Study on hydrophobic properties of two-dimensional grating on fluorine-containing azobenzene polymer film [9667-15]
9667 OB	Method for the measurement of surface-relief grating's profile using initial phase of diffraction wave [9667-16]
9667 0C	Both improvements of the light extraction efficiency and scattered angle of GaN-LED using sub-micron Fresnel lens array [9667-22]
9667 0D	The transmission volume-phase holographic grating recorded on dichromated gelatin film used in Raman spectrometer [9667-26]
9667 OE	Research on multi-source data integration and the extraction of three-dimensional displacement field based on GBSAR [9667-9]
9667 OF	A comparison of atmospheric disturbance correction techniques in GBInSAR [9667-7]
9667 0G	High order aspheric optical compensation system research [9667-20]

9667 0T **A** fabrication approach of ionic polymer-metal composite for deformation sensors [9667-41]

## **Authors**

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

Cerny, Charles, 05 Chen, Dong, 0T Chen, Linsen, 07, 0C Dong, Ruili, OT Feng, Fanrong, OB Gao, Fei, OB Gu, Xinyu, 0C Guo, Leping, 0E Gupta, Reema, 03 Gupta, Vinay, 03, 06 He, Hong, OT Jiang, Yingjie, 07 Kaur, Gurpreet, 06 Leedy, Kevin, 05 Liu, Peng, 0D

Ning, Ning, 02 Ogudo, Kingsley A., 02 Peng, Changsi, 07 Polleux, Jean-Luc, 02 Qiu, Shanming, OF Qiu, Zhiwei, 0F Quach, Tony, 05 Rui, Guanahao, 09 Shen, Donghui, 0G Shen, Su, OC

Mei, Qijing, 0D

Shi, Zhenwu, 07 Shin, Eunsung, 04, 05 Snyman, Lukas W., 02

Spatz, Devin, 04

Subramanyam, Guru, 04, 05 Tan, Yonghong, 0T

Tang, Minxue, 0D Tomar, Monika, 03, 06 Wan, Wenqiang, 0C Wang, Jian, 0A Wang, Shu, 04, 05

Wang, Weisong, 05

Wang, Xueqin, 0E, 0F

Wu, Jianhong, OA, OB

Xie, Bin, 0G

Xu, Kaikai, 02

Xu, Lixiong, 0A

Yang, Zhenyu, 08

Yu, Lingling, 0G

Yu, Qi, 02

Yue, Hailing, 04

Yue, Jianping, 0E, 0F

Yue, Shun, OE, OF

Zhan, Qiwen, 08, 09 Zhang, Congyue, 0G Zhang, Feng, 07 Zhou, Xiaohong, 07 Zong, Liang, 0G

Proc. of SPIE Vol. 9667 966701-6

## **Conference Committee**

#### Conference Chair

Guru Subramanyam, University of Dayton (United States)

#### Conference Co-chairs

Chinhua Wang, Soochow University (China)

Qiwen Zhan, University of Dayton (United States)

Chonglin Chen, The University of Texas at San Antonio (United States)

#### Conference Review Committee

**Andrew M. Sarangan**, University of Dayton (United States)

Andrew J. Steckl, University of Cincinnati (United States)

Chonglin Chen, The University of Texas at San Antonio (United States)

K. C. James Raju, University of Hyderabad (India)

Eunsung Shin, University of Dayton Research Institute (United States)

Imad H. Agha, University of Dayton (United States)

James G. Grote, Air Force Research Laboratory (United States)

Joseph W. Haus, University of Dayton (United States)

**Karolyn M. Hansen**, University of Dayton (United States)

Nian X. Sun, Northeastern University (United States)

Partha P. Banerjee, University of Dayton (United States)

**Paul Terrence Murray**, University of Dayton Research Institute (United States)

Chungkun Song, Dong-A University (Korea, Republic of)

Chinhua Wang, Soochow University (China)

Wenyan Xu, Yanshan University (China)

Keqin Zhang, Soochow University (China)

Qiwen Zhan, University of Dayton (United States)

Ram Kativar, University of Puerto Rico (Puerto Rico)

Yu Wang, The Hong Kong Polytechnic University (Hong Kong, China)

Wen Li, Michigan State University (United States)

**Nelson Sepulveda**, Michigan State University (United States)

**Jitendra Kumar**, University of Dayton (United States)

**Sandwip Dey**, Arizona State University (United States)

**Weisong Wang**, University of Dayton (United States)

Wen Lu, Zhejiang Naboor Power Technology Inc. (China)

Proc. of SPIE Vol. 9667 966701-8

## Introduction

The inaugural International Workshop on Thin-films for Electronics, Electro-Optics, Energy and Sensors (TFE3S) was successfully held from 4-6 July 2015 at the University of Dayton China Institute (Suzhou, China). This workshop was organized by the University of Dayton, the University of Dayton China Institute, Soochow University, and Nanjing University of Science and Technology. Prof. Guru Subramanyam from the Center of Excellence for Thin-film Research and Surface Engineering (CETRASE), University of Dayton served as program chair. The University of Dayton China Institute and the Dushu Lake Science & Education Development Co. Ltd. provided local logistic services for the workshop. There were 83 participants, which included over 50 invited speakers and three plenary speakers, from the United States, India, Germany, Korea, Japan and China. The workshop set up 11 sessions related to different areas of thin-films. Accepted papers are published by SPIE as a proceedings volume.

Proc. of SPIE Vol. 9667 966701-10