

# PROCEEDINGS OF SPIE

## ***Nanosensors, Microsensors, and Biosensors and Systems 2007***

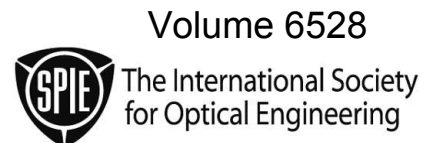
**Vijay K. Varadan**  
*Editor*

**21–22 March 2007**  
**San Diego, California, USA**

*Sponsored and Published by*  
SPIE—The International Society for Optical Engineering

*Cosponsored by*  
American Society of Mechanical Engineers (USA)

*Cooperating Organizations*  
Intelligent Materials Forum (Japan)  
Jet Propulsion Laboratory (USA)  
National Science Foundation (USA)



Proceedings of SPIE—The International Society for Optical Engineering, 9780819466495, v. 6528

SPIE is an international technical society dedicated to advancing engineering and scientific applications of optical, photonic, imaging, electronic, and optoelectronic technologies.

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 *Nanosensors, Microsensors, and Biosensors and Systems 2007*, edited by Vijay K. Varadan, Proceedings of SPIE Vol. 6528 (SPIE, Bellingham, WA, 2007) Article CID Number.

ISSN 0277-786X  
ISBN 9780819466495

Published by  
**SPIE—The International Society for Optical Engineering**  
P.O. Box 10, Bellingham, Washington 98227-0010 USA  
Telephone 1 360/676-3290 (Pacific Time) · Fax 1 360/647-1445  
<http://www.spie.org>

Copyright © 2007, The 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 <http://www.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/07/\$18.00.

Printed in the United States of America.

# Contents

ix	<i>Symposium Committee</i>
xi	<i>Conference Committee</i>

---

## SESSION 1 KEYNOTE LECTURE

---

- 652802 **MEMS-based phased arrays for Army applications (Keynote Paper)** [6528-55]  
P. B. Ruffin, J. C. Holt, J. H. Mullins, T. Hudson, J. Rock, U.S. Army Research, Development, and Engineering Command (USA)

---

## SESSION 2 NANOWIRE AND NANOTUBE

---

- 652803 **Elastic and magneto-elastic modeling of Galfenol nanowires** [6528-62]  
C. Mudivarathi, P. Downey, A. B. Flatau, Univ. of Maryland, College Park (USA)
- 652804 **Bio-inspired electric cilia development for biomedical applications: use of ionic electro-active polymer, nanowire arrays, and micro-stereo-lithography** [6528-41]  
H. Yoon, V. Ramachandran, D. C. Deshpande, V. K. Varadan, Univ. of Arkansas (USA)
- 652805 **Packaging of an iron-gallium (Galfenol) nanowire acoustic sensor** [6528-63]  
R. Jain, F. P. McCluskey, A. B. Flatau, Univ. of Maryland, College Park (USA); B. J. H. Stadler, Univ. of Minnesota (USA)
- 652806 **Autonomous multifunctional nanobrushes-autonomous materials (Keynote Paper)** [6528-96] M. N. Ghasemi-Nejhad, M. A. Tius, Univ. of Hawaii at Manoa (USA)
- 652809 **Modeling of carbon nanotube composites for vibration damping** [6528-89]  
R. L. Dai, W. H. Liao, The Chinese Univ. of Hong Kong (Hong Kong China)

---

## SESSION 3 MICRO/NANO DEVICES AND MEMS

---

- 65280A **U.S. Army Corrosion Office's storage and quality requirements for military MEMS program** [6528-27] J. L. Zunino III, D. R. Skelton, U.S. Army Research, Development, and Engineering Command (USA)

---

**Pagination:** 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.

- 65280B **NanoDAC: object deformation measurements for micro and nanotechnology applications** [6528-40]  
J. Keller, AMIC, Angewandte Micro-Messtechnik GmbH (Germany) and Fraunhofer Institute for Reliability and Microintegration, IZM (Germany); D. Vogel, B. Michel, Fraunhofer Institute for Reliability and Microintegration, IZM (Germany)
- 65280C **Micro-mold fabrication using cellulose acetate** [6528-18]  
K. Y. Cho, H. K. Lim, Y. Chen, J. Kim, K. S. Kang, Inha Univ. (South Korea)
- 65280D **Comparison of techniques for measurement of residual stresses in multilayered micro-electro-mechanical devices** [6528-13]  
M. Vechev, Univ. of Maryland, College Park (USA) and Army Research Lab. (USA); A. Dick, B. Balachandran, Univ. of Maryland, College Park (USA); M. Dubey, Army Research Lab. (USA)

---

#### SESSION 4 APPLICATIONS I

---

- 65280F **Concentration effect of the Au-pattern on a cellulose paper using  $\mu$ -contact printing technique** [6528-16]  
H. K. Lim, K. Y. Cho, J. Kim, K. S. Kang, Inha Univ. (South Korea)
- 65280H **Active coatings technologies for tailorable military coating systems** [6528-24]  
J. L. Zunino III, U.S. Army Research, Development, and Engineering Command (USA)
- 65280I **Fabrication of nonlinear plastic optical fiber (POF) and application** [6528-32]  
E. S. Kim, Pusan Univ. of Foreign Studies (South Korea); T. Kinoshita, Keio Univ. (Japan); Y. S. Yu, Dongeui Univ. (South Korea); M. Y. Jeong, Pusan National Univ. (South Korea)
- 65280J **Lifetime characterization of powercapacitive RF MEMS switches** [6528-01]  
A. Ziaei, Thales Research and Technology France (France)
- 65280K **Energy harvesting of dipole rectenna for airship applications** [6528-60]  
K. D. Song, T. B. Stout, Norfolk State Univ. (USA); S. Y. Yang, J. Kim, Inha Univ. (South Korea); S. H. Choi, NASA Langley Research Ctr. (USA)

---

#### SESSION 5 NANOSTRUCTURES

---

- 65280L **Experimental investigation of magnetic nanotubes in PC-12 neuron cells culturing** [6528-51]  
L. Chen, J. Xie, Univ. of Arkansas (USA); J. Yancey, M. Srivatsan, Arkansas State Univ. (USA); V. K. Varadan, Univ. of Arkansas (USA)
- 65280M **Nano-bio quantum technology for device-specific materials (Keynote Paper)** [6528-56]  
S. H. Choi, NASA Langley Research Ctr. (USA)

---

#### SESSION 6 BIOSENSORS AND BIOMEMS I

---

- 65280N **High-speed microfluidic thermal stimulator for temperature-activated ion channel studies** [6528-02]  
T. Pennell, J. Wang, S. Z. Hua, State Univ. of New York, Buffalo (USA)

- 65280O **Nanowire integrated microelectrode arrays for lab-on-a-chip applications** [6528-42]  
J. K. Abraham, H. Yoon, V. Varadan, Univ. of Arkansas (USA); R. Chintakuntla, Micron Technologies (USA)
- 65280P **A miniature fiber optic pressure sensor for intervertebral disc pressure measurements of rodents** [6528-09]  
S. Nesson, M. Yu, A. H. Hsieh, Univ. of Maryland, College Park (USA)

---

**SESSION 7 BIOSENSORS AND BIOMEMS II**

---

- 65280Q **Immersive training and mentoring for laparoscopic surgery** [6528-39]  
V. Nistor, B. Allen, E. Dutson, P. Faloutsos, G. P. Carman, Univ. of California, Los Angeles (USA)
- 65280R **A total patient monitoring system for point-of-care applications** [6528-44]  
A. K. Whitchurch, J. K. Abraham, V. K. Varadan, Univ. of Arkansas (USA)
- 65280S **Electro-fluid-structural interaction simulation of a valveless micropump** [6528-17]  
G. Li, N. S. Goo, D. Byun, Konkuk Univ. (South Korea)
- 65280T **On-line carbon nanotube-based biosensors in microfluidic channels** [6528-11]  
Y. Yun, Z. Dong, V. N. Shanov, A. Bange, W. R. Heineman, H. B. Halsall, L. Conforti, A. Bhattacharya, M. J. Schulz, Univ. of Cincinnati (USA)

---

**SESSION 8 BIOSENSORS AND BIOMEMS III**

---

- 65280U **Integrated polymer multimode waveguides for microfluidic sensing applications** [6528-50]  
Th. Otto, Fraunhofer Institute for Reliability and Microintegration (Germany); J. Nestler, M. Baum, Chemnitz Univ. of Technology (Germany); H. Schroeder, F. Ebling, Fraunhofer Institute for Reliability and Microintegration (Germany); R. Bruch, Nanolife Chemnitz GmbH (Germany); Th. Gessner, Fraunhofer Institute for Reliability and Microintegration (Germany) and Chemnitz Univ. of Technology (Germany)
- 65280V **Piezoelectric 3D nanostructures for developing point-of-care biosensors** [6528-43]  
J. K. Abraham, S. Dubaka, V. K. Varadan, H. Zhou, T. Zhang, Z. R. Tian, Univ. of Arkansas (USA)
- 65280W **MEMS glaucoma monitoring device** [6528-36]  
S. Shankar, GE India Technology Ctr. (India); M. Austin, Royal Melbourne Institute of Technology (Australia)
- 65280X **Viability study of oscillatory flow pumps using bimorph piezoelectric actuators** [6528-28]  
S. L. Vatanabe, Escola Politécnica da Univ. de São Paulo (Brazil); R. F. Pires, A. Choi, Inoveo Pesquisa e Desenvolvimento de Produtos e Projetos de Automação de Sistemas Ltda. (Brazil); P. H. Nakasone, E. C. N. Silva, Escola Politécnica da Univ. de São Paulo (Brazil)

---

**SESSION 9 APPLICATIONS II**

---

- 65280Y **Measurement of stresses in MEMS structures by stress release** [6528-30]  
D. Vogel, Micro Materials Ctr. Berlin, Fraunhofer IZM (Germany); N. Sabate, Ctr. Nacional de Microelectrónica, CNM-CSIC (Spain); A. Gollhardt, B. Michel, Micro Materials Ctr. Berlin, Fraunhofer IZM (Germany)

- 65280Z **Three-dimensional fiber optical trap for cell manipulation and force measurement** [6528-12]  
Y. Liu, M. Yu, Univ. of Maryland, College Park (USA)
- 652810 **D-Fiber volatile organic compound sensor** [6528-10]  
J. D. Gordon, R. H. Selfridge, S. M. Schultz, Brigham Young Univ. (USA)
- 652811 **Hologram-based humidity indicator for domestic and packaging applications** [6528-29]  
I. Naydenova, R. Jallapuram, V. Toal, S. Martin, Dublin Institute of Technology (Ireland)
- 652812 **Uncertainty analysis of microresonator using classical and interval methods** [6528-23]  
B. Vasuki, M. Umapathy, G. Uma, M. Shanmugavalli, National Institute of Technology, Tiruchirappalli (India); S. Meenatchisundaram, Manipal Institute of Technology (India)

---

#### SESSION 10 PACKAGING

- 652813 **The role of nanotechnology and nano and micro-electronics in monitoring and control of cardiovascular diseases and neurological disorders (Keynote Paper)** [6528-57]  
V. K. Varadan, Univ. of Arkansas (USA) and Pennsylvania State Univ. (USA)

---

#### SESSION 11 INTEGRATED NANO- AND MICRO-STRUCTURES

- 652815 **Development of poly-3-hexylthiophene based ISFET sensors for biomedical applications** [6528-59]  
P. Rai, S. Jung, T. Ji, V. K. Varadan, Univ. of Arkansas (USA)
- 652816 **Memory-based robust adaptive control of a variable length stepping nanomanipulator** [6528-15]  
R. Saeidpourazar, N. Jalili, Clemson Univ. (USA)
- 652817 **Studying insect motion with piezoelectric sensors** [6528-21]  
B. Mika, H. Lee, J. M. González, S. B. Vinson, H. Liang, Texas A&M Univ. (USA)
- 652819 **Development of amperometric glucose sensors with heterostructured nanowire arrays for continuous subcutaneous monitoring** [6528-48]  
D. C. Deshpande, H. Yoon, A. M. Khaing, V. K. Varadan, Univ. of Arkansas (USA)

---

#### SESSION 12 FABRICATION AND CHARACTERIZATION

- 65281A **Coupled flexural-torsional nonlinear vibrations of microcantilever beams** [6528-14]  
S. N. Mahmoodi, N. Jalili, Clemson Univ. (USA)
- 65281B **Visualization of buried structures in atomic force acoustic microscopy** [6528-38]  
A. Striegler, B. Köhler, B. Bendjus, Fraunhofer Institute for Non-Destructive Testing (Germany); N. Pathuri, N. Meyendorf, Univ. of Dayton (USA)
- 65281D **Study of the transverse shear mode resonator with coupled viscoelastic layer by scanning tunneling microscopy** [6528-19]  
C.-Y. Wu, C.-K. Chen, K.-C. Wu, W.-J. Wu, C.-K. Lee, National Taiwan Univ. (Taiwan)

---

## POSTER SESSION

---

- 65281E **Microwave power transmission of flexible dipole rectenna for smart sensors and devices** [6528-20]  
S. Y. Yang, J. Kim, Inha Univ. (South Korea); K. D. Song, Norfolk State Univ. (USA); S. H. Choi, NASA Langley Research Ctr. (USA)
- 65281F **Immobilization of  $\epsilon$ -polylysine onto the probe surface for molecular adsorption type endotoxin detection system** [6528-22]  
K. Ooe, A. Tsuji, Ritsumeikan Univ. (Japan); N. Nishishita, Y. Hirano, Osaka Institute of Technology (Japan)
- 65281G **Dynamic simulation of microresonator-based differential pressure sensor** [6528-25]  
G. Uma, M. Umapathy, National Institute of Technology, Tiruchirappalli (India); S. Meenatchisundaram, Manipal Institute of Technology (India)
- 65281H **Variable structure control of shape memory alloy actuated flexible smart structure** [6528-26]  
K. Dhanalakshmi, M. Umapathy, D. Ezhilarasi, National Institute of Technology, Tiruchirappalli (India)
- 65281J **Cylindrical nanocavity and nanowire electrodes for redox cycle dopamine sensing: design, fabrication, and characterization** [6528-45]  
P. T. Hankins, H. Yoon, V. K. Varadan, Univ. of Arkansas (USA)
- 65281K **Glucose sensing based on Pt-MWCNT and MWCNT** [6528-46]  
L. Aryasomayajula, J. Xie, S. Wang, V. K. Varadan, Univ. of Arkansas (USA)
- 65281L **Synthesis and photonic property study of ZnO nanowires for a real time photodynamic therapy monitoring probe** [6528-47]  
D. Sridhar, J. Xie, J. K. Abraham, V. K. Varadan, Univ. of Arkansas (USA)
- 65281M **On the size-dependent behavior of the micro-wire in the micro-tensile test** [6528-54]  
S. Ko, B. Jung, H. Lee, H. Park, Pohang Univ. of Science and Technology (South Korea)
- 65281O **Wideband microwave absorber design using micro and nanomaterials** [6528-64]  
J. K. Abraham, Univ. of Arkansas (USA); T. C. Shami, A. K. Dixit, R. Dubey, A. Jain, Defence Materials and Stores Research & Development Establishment (India); V. K. Varadan, Univ. of Arkansas (USA); K. U. Bhasker Rao, Defence Materials and Stores Research & Development Establishment (India)
- 65281P **Design and fabrication of OTFT based flexible piezoelectric sensor** [6528-65]  
T. Ji, Univ. of Arkansas (USA); M. Kathiresan, S. Nair, Naval Physical and Oceanographic Lab. (India); S. Jung, Univ. of Arkansas (USA); V. Natarajan, R. M. R. Vishnubhatla, Naval Physical and Oceanographic Lab. (India); V. K. Varadan, Univ. of Arkansas (USA)

*Revolutionary transitions of GE technology in NDE Prognostics and health monitoring (Plenary Presentation) E. Hindle, T. Patton, GE Aviation (USA), T. Batzinger, GE Global Research Ctr. (USA)*

*Author Index*





# Symposium Committee

## *Symposium Chairs*

**Yoseph Bar-Cohen**, Jet Propulsion Laboratory (USA)  
**Alison B. Flatau**, University of Maryland, College Park (USA)  
**Norbert G. Meyendorf**, University of Dayton (USA) and Fraunhofer Institute  
of Non-Destructive Testing (Germany)  
**George Y. Baaklini**, NASA Glenn Research Center (USA)

## *Executive Committee*

**Mehdi Ahmadian**, Virginia Polytechnic Institute and State University (USA)  
**George Y. Baaklini**, NASA Glenn Research Center (USA)  
**Yoseph Bar-Cohen**, Jet Propulsion Laboratory (USA)  
**Marcelo J. Dapino**, The Ohio State University (USA)  
**L. Porter Davis**, Honeywell, Inc. (USA)  
**Michael A. Demetriou**, Worcester Polytechnic Institute (USA)  
**Aaron A. Diaz**, Pacific Northwest National Laboratory (USA)  
**Alison B. Flatau**, University of Maryland, College Park (USA)  
**Victor Giurgiutiu**, University of South Carolina (USA)  
**B. K. Henderson**, Air Force Research Laboratory (USA)  
**Kumar Jata**, Air Force Research Laboratory (USA)  
**Gabor M., Kovacs**, EMPA (Switzerland)  
**Tribikram Kundu**, The University of Arizona (USA)  
**Donald J. Leo**, DARPA (USA) and Virginia Polytechnic Institute and State  
University (USA)  
**Douglas K. Lindner**, Virginia Polytechnic Institute and State University  
(USA)  
**Ajit K. Mal**, University of California, Los Angeles (USA)  
**Yuji Matsuzaki**, Nagoya University (Japan)  
**M. Brett McMickell**, Honeywell, Inc. (USA)  
**Norbert G. Meyendorf**, University of Dayton (USA)  
**Zoubeida Ounaies**, Texas A&M University (USA)  
**Kara J. Peters**, North Carolina State University (USA)  
**Peter J. Shull**, The Pennsylvania State University (USA)  
**Masayoshi Tomizuka**, University of California, Berkeley (USA)  
**Eric Udd**, Columbia Gorge Research (USA)  
**Vijay K. Varadan**, University of Arkansas (USA)  
**Dietmar W. Vogel**, Fraunhofer-Institut für Zuverlässigkeit und  
Mikrointegration (Germany)  
**H. Felix Wu**, National Institute of Standards and Technology (USA)  
**Chung-Bang Yun**, Korea Advanced Institute of Science and Technology  
(South Korea)



# Conference Committee

## *Conference Chair*

**Vijay K. Varadan**, University of Arkansas (USA)

## *Conference Cochair*

**Dietmar W. Vogel**, Fraunhofer-Institut für Zuverlässigkeit und  
Mikrointegration (Germany)

## *Program Committee*

**Pratul K. Ajmera**, Louisiana State University (USA)  
**Steven W. Arms**, MicroStrain, Inc. (USA)  
**Joachim F. Baumann**, Siemens AG (Germany)  
**Bharat Bhushan**, The Ohio State University (USA)  
**James L. Blackshire**, Air Force Research Laboratory (USA)  
**David L. Carroll**, Wake Forest University (USA)  
**Jung-Chih Chiao**, The University of Texas at Arlington (USA)  
**Sang H. Choi**, NASA Langley Research Center (USA)  
**András Dér**, Biological Research Center (Hungary)  
**Jürg Dual**, ETH Zürich (Switzerland)  
**Lukas M. Eng**, Technische Universität Dresden (Germany)  
**Cläs-Göran Granqvist, Sr.**, Uppsala Universitet (Sweden)  
**Peter Heszler, Sr.**, Uppsala Universitet (Sweden)  
**Michael H. Hoffmann**, Universität Ulm (Germany)  
**Laszlo B. Kish**, Texas A&M University (USA)  
**Nikhil A. Koratkar**, Rensselaer Polytechnic Institute (USA)  
**Shriram B. Kumar**, University of Arkansas (USA)  
**Chih-Hao Lee**, National Tsing Hua University (Taiwan)  
**Eric Lifshin**, University at Albany, SUNY (USA)  
**Cheng Luo**, Louisiana Tech University (USA)  
**William H. Marlow**, Texas A&M University (USA)  
**Conrad Masterson**, Nanotechnology Foundation of Texas, Inc. (USA)  
**Kathryn M. McGrath**, University of Otago (New Zealand)  
**Norbert G. Meyendorf**, University of Dayton (USA)  
**Bernd Michel**, Fraunhofer-Institut für Zuverlässigkeit und Mikrointegration  
(Germany)  
**Y. Eugene Pak**, Samsung Advanced Institute of Technology (South Korea)  
**Yeonjoon Park**, NASA Langley Research Ctr. (USA)  
**Yongrae Roh**, Kyungpook National University (South Korea)  
**Paul B. Ruffin**, U.S. Army Aviation and Missile Research, Development and  
Engineering Ctr. (USA)  
**Gabor Schmera**, Space and Naval Warfare Systems Center, San Diego  
(USA)

**Ananth Selvarajan**, Indian Institute of Science (India)  
**Andrei M. Shkel**, University of California, Irvine (USA)  
**Kyo D. Song**, Norfolk State University (USA)  
**Ashok Srivastava**, Louisiana State University (USA)  
**Maria Strømme**, Uppsala Universitet (Sweden)  
**Joseph A. Turner**, University of Nebraska, Lincoln (USA)  
**Lode K. Vandamme**, Technische Universiteit Eindhoven (Netherlands)  
**Tian-Bing Xu**, National Institute of Aerospace (USA)  
**Kazushi Yamanaka**, Tohoku University (Japan)  
**Kaiming Ye**, University of Arkansas (USA)

### *Session Chairs*

- 1 Keynote Lecture  
**Vijay K. Varadan**, University of Arkansas (USA)
- 2 Nanowire and Nanotube  
**Vijay K. Varadan**, University of Arkansas (USA)  
**Mehrdad N. Ghasemi-Nejhad**, University of Hawaii at Manoa (USA)
- 3 Micro/Nano Devices and MEMS  
**Jaehwan Kim**, Inha University (South Korea)  
**Hargsoon Yoon**, University of Arkansas (USA)
- 4 Applications I  
**Tian-Bing Xu**, National Institute of Aerospace (USA)  
**K. S. Kang**, Inha University (South Korea)
- 5 Nanostructures  
**Vijay K. Varadan**, University of Arkansas (USA)
- 6 Biosensors and BioMEMS I  
**Jose K. Abraham**, University of Arkansas (USA)  
**Katsutoshi Ooe**, Ritsumeikan University (Japan)
- 7 Biosensors and BioMEMS II  
**Hargsoon Yoon**, University of Arkansas (USA)  
**YeoHeung Yun**, University of Cincinnati (USA)
- 8 Biosensors and BioMEMS III  
**Thomas Otto**, Fraunhofer-Institut für Zuverlässigkeit und Mikrointegration (Germany)  
**Smitha Shankar**, Royal Melbourne Institute of Technology (Australia)
- 9 Applications II  
**Jose K. Abraham**, University of Arkansas (USA)

- 10 Packaging  
**Silke Spiesshoefer**, NeoNanoSys (USA)
- 11 Integrated Nano- and Micro-structures  
**Hargsoon Yoon**, University of Arkansas (USA)  
**Taeksoo Ji**, University of Arkansas (USA)
- 12 Fabrication and Characterization  
**Dietmar W. Vogel**, Fraunhofer-Institut für Zuverlässigkeit und  
Mikrointegration (Germany)  
**Chueh-Yu Wu**, National Taiwan University (Taiwan)

