

# PROCEEDINGS OF SPIE

## ***Smart Sensors, Actuators, and MEMS V***

**Ulrich Schmid**  
**José Luis Sánchez-Rojas**  
**Monika Leester-Schaedel**  
*Editors*

**18–20 April 2011**  
**Prague, Czech Republic**

*Sponsored and Published by*  
SPIE

**Volume 8066**

Proceedings of SPIE, 0277-786X, v. 8066

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

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 *Smart Sensors, Actuators, and MEMS V*, edited by Ulrich Schmid, José Luis Sánchez-Rojas, Monika Leester-Schaedel, Proceedings of SPIE Vol. 8066 (SPIE, Bellingham, WA, 2011) Article CID Number.

ISSN 0277-786X  
ISBN 9780819486554

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.org

Copyright © 2011, 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](http://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/11/\$18.00.

Printed in the United States of America.

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



[SPIDigitalLibrary.org](http://SPIDigitalLibrary.org)

---

**Paper Numbering:** 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 as 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. Numbers in the index correspond to the last two digits of the six-digit CID number.

# Contents

xiii	<i>Conference Committee</i>
xvii	<i>Introduction</i>

---

## SESSION 1 HIGH TEMPERATURE SENSORS

---

- 8066 02 **Wireless SAW sensor for high temperature applications: material point of view (Invited Paper)** [8066-01]  
O. Elmazria, T. Aubert, CNRS, Institut Jean Lamour, Nancy Univ. (France)
- 8066 03 **Design and fabrication of piezoresistive p-SOI Wheatstone bridges for high-temperature applications** [8066-02]  
J. Kähler, Technische Univ. Braunschweig (Germany); L. Döring, Physikalisch-Technische Bundesanstalt (Germany); S. Merzsch, A. Stranz, A. Waag, E. Peiner, Technische Univ. Braunschweig (Germany)
- 8066 04 **Microthruster with integrated platinum thin film resistance temperature detector (RTD), heater, and thermal insulation** [8066-03]  
N. Miyakawa, W. Legner, T. Ziemann, EADS Innovation Works (Germany); D. Telitschkin, Astrium GmbH Space Transportation (Germany); H.-J. Fecht, Univ. Ulm (Germany); A. Friedberger, EADS Innovation Works (Germany)
- 8066 05 **Miniaturized piezoelectric structures for application temperatures up to 1000 °C** [8066-04]  
S. Schmidtchen, J. Sauerwald, D. Richter, H. Fritze, Clausthal Univ. of Technology (Germany)
- 8066 06 **Thin film electrodes and passivation coatings for harsh environment microwave acoustic sensors** [8066-05]  
S. C. Moulzolf, D. J. Frankel, G. P. Bernhardt, B. Nugent, R. J. Lad, Univ. of Maine (United States)

---

## SESSION 2 MATERIALS

---

- 8066 07 **Smart ultrasonic sensors systems: investigations on aluminum nitride thin films for the excitation of high frequency ultrasound** [8066-06]  
S. Walter, T. Herzog, H. Heuer, Fraunhofer Institute for Non-Destructive Testing (Germany); H. Bartzsch, D. Gloess, Fraunhofer Institute for Electron Beam and Plasma Technology (Germany)
- 8066 08 **Measurement of Young's modulus and residual stress of thin SiC layers for MEMS high temperature applications** [8066-07]  
O. Pabst, Fraunhofer Institute for Applied Optics and Precision Engineering (Germany) and Friedrich Schiller Univ. Jena (Germany); M. Schiffer, TDK-EPCOS Corp. (Germany); E. Obermeier, T. Tekin, K. D. Lang, H.-D. Ngo, Technical Univ. of Berlin (Germany)

- 8066 09 **Mechanical properties of 1  $\mu\text{m}$ -thick metallic freestanding coatings measured by in-plane uniaxial stress** [8066-08]  
T. Fourcade, NOVA MEMS (France), CNES (France), and Univ. de Toulouse (France); C. Seguineau, NOVA MEMS (France); J. M. Desmarres, CNES (France); T. Masri, J. Alexis, O. Dalverny, Univ. de Toulouse (France); J. Martegoutte, CNES (France), Univ. de Toulouse (France), and INL, CNRS, INSA de Lyon (France); X. Lafontan, NOVA MEMS (France)
- 8066 0A **Fabrication process and characterization of micromechanical sensors based on SU-8 resist** [8066-09]  
A. Jordan, S. Büttgenbach, Technische Univ. Braunschweig (Germany)
- 8066 0B **On-device extraction of thermal thin-film properties in calorimetric flow sensors** [8066-10]  
R. Beigelbeck, A. Talic, Institute for Integrated Sensor Systems (Austria); S. Cerimovic, Institute for Integrated Sensor Systems (Austria) and Vienna Univ. of Technology (Austria); F. Kohl, Institute for Integrated Sensor Systems (Austria); F. Keplinger, Vienna Univ. of Technology (Austria)
- 8066 0C **Thin catalyst layers based on carbon nanotubes for PEM-fuel cell applications** [8066-11]  
T. Bohnenberger, J. Matovic, U. Schmid, Vienna Univ. of Technology (Austria)

---

**SESSION 3 BIO-MEMS**

- 8066 0D **Poly(dimethylsiloxane) photonic microreactors and multiple internal reflection systems for real time cell screening (Invited Paper)** [8066-12]  
P. Ortiz, Ctr. Nacional de Microelectrónica (Spain); S. Demming, Univ. Autònoma de Barcelona (Spain); E. Fernández-Rosas, Technische Univ. Braunschweig (Germany); B. Ibarlucea, J. Vila-Planas, Ctr. Nacional de Microelectrónica (Spain); S. Büttgenbach, Univ. Autònoma de Barcelona (Spain); A. Llobera, Ctr. Nacional de Microelectrónica (Spain) and Univ. Autònoma de Barcelona (Spain)
- 8066 0E **Mid-infrared CH<sub>2</sub>-stretch ratio sensor for suspended mammalian cells** [8066-13]  
S. van den Driesche, C. Haiden, Vienna Univ. of Technology (Austria); W. Witarski, Institute of Virology (Slovakia); M. J. Vellekoop, Vienna Univ. of Technology (Austria)
- 8066 0F **Optimization of an impedance sensor for droplet-based microfluidic systems** [8066-76]  
B. P. Cahill, Institute for Bioprocessing and Analytical Measurement Techniques (Germany)
- 8066 0G **Microfluidic cartridges for DNA purification and genotyping processed in standard laboratory instruments** [8066-15]  
M. Focke, Univ. of Freiburg (Germany); D. Mark, F. Stumpf, Institut für Mikrotechnik und Informationstechnik (HSG-IMIT) (Germany); M. Müller, G. Roth, Univ. of Freiburg (Germany); R. Zengerle, Univ. of Freiburg (Germany) and Institut für Mikrotechnik und Informationstechnik (HSG-IMIT) (Germany); F. von Stetten, Institut für Mikrotechnik und Informationstechnik (HSG-IMIT) (Germany)

---

**SESSION 4    GAS SENSORS**

---

- 8066 OI    **New method for selectivity enhancement of SiC field effect gas sensors for quantification of NO<sub>x</sub>** [8066-17]  
C. Bur, P. Reimann, Saarland Univ. (Germany); M. Andersson, A. Lloyd Spetz, Linköping Univ. (Sweden); A. Schütze, Saarland Univ. (Germany)
- 8066 OJ    **Fabrication of a miniaturized ionization gas sensor with polyimide spacer** [8066-18]  
T. Walewyns, G. Scheen, E. Tooten, L. El Fissi, P. Dupuis, L. A. Francis, Univ. Catholique de Louvain (Belgium)
- 8066 OK    **Fabry-Pérot-based thin film structure used as IR-emitter of an NDIR gas sensor: ray tracing simulations and measurements** [8066-19]  
J. Mayrwöger, Johannes Kepler Univ. Linz (Austria); C. Mitterer, Univ. of Leoben (Austria); W. Reichl, E+E Elektronik (Austria); C. Krutzler, Integrated Microsystems Austria (Austria); B. Jakoby, Johannes Kepler Univ. Linz (Austria)
- 8066 OL    **Metallo-porphyrins as gas sensing material for colorimetric gas sensors on planar optical waveguides** [8066-20]  
C. Peter, K. Schmitt, M. Schiel, Fraunhofer Institute for Physical Measurement Techniques (Germany); J. Wöllenstein, Fraunhofer Institute for Physical Measurement Techniques (Germany) and Univ. of Freiburg (Germany)
- 8066 ON    **Gas sensors based on MEMS structures made of ceramic ZrO<sub>2</sub>/Y<sub>2</sub>O<sub>3</sub> material** [8066-22]  
A. A. Vasiliev, Kurchatov Institute (Russian Federation); A. S. Lipilin, Institute of Electrophysics (Russian Federation); A. M. Mozalev, Belarus State Univ. of Radioelectronics and Informatics (Russian Federation); A. S. Lagutin, A. V. Pisiakov, N. P. Zaretskiy, N. N. Samotaev, A. V. Sokolov, Kurchatov Institute (Russian Federation)

---

**SESSION 5    OPTICAL DEVICES AND SYSTEMS**

---

- 8066 OO    **Closed-loop synchronization scheme of resonant MOEMS-mirrors with two axes** [8066-23]  
A. Tortschanoff, A. Frank, M. Lenzhofer, Carinthian Tech Research AG (Austria); M. Wildenhain, T. Sandner, Fraunhofer Institute for Photonic Microsystems (Germany); A. Kenda, Carinthian Tech Research AG (Austria)
- 8066 OP    **Design of linear and nonlinear hybrid optical MEMS displacement sensors** [8066-24]  
W. Hortschitz, F. Kohl, H. Steiner, M. Sachse, M. Stifter, Institute for Integrated Sensor Systems (Austria); J. Schalko, Institute for Integrated Sensor Systems (Austria) and Vienna Univ. of Technology (Austria); A. Jachimowicz, F. Keplinger, Vienna Univ. of Technology (Austria)
- 8066 OQ    **Miniaturized multi channel infrared optical gas sensor system** [8066-25]  
J. Wöllenstein, Fraunhofer Institute for Physical Measurement Techniques (Germany) and Univ. of Freiburg (Germany); A. Eberhardt, S. Rademacher, K. Schmitt, Fraunhofer Institute for Physical Measurement Techniques (Germany)
- 8066 OR    **A polyvinylidene fluoride (PVDF) based bimorph actuator for high speed laser beam manipulation** [8066-26]  
R. Pérez, M. Král, H. Bleuler, R. Clavel, Ecole Polytechnique Fédérale de Lausanne (Switzerland)

- 8066 OS **A systems engineering approach to structural health monitoring of composites using embedded optical fibre Bragg sensors for aeronautical applications** [8066-27]  
A. J. van Wyk, C. V. Roberson, Univ. of Johannesburg (South Africa)
- 8066 OT **Impact damage detection of composite materials by fiber Bragg gratings** [8066-28]  
Z. Djinovic, Integrated Microsystems Austria (Austria); M. Scheerer, Aerospace & Advanced Composites (Austria); M. Tomic, Univ. of Belgrade (Serbia)

---

## SESSION 6 HIGH-FREQUENCY MEMS

---

- 8066 OU **Electro-acoustic sensors based on AlN thin film: possibilities and limitations (Invited Paper)** [8066-29]  
G. Wingqvist, Linköping Univ. (Sweden)
- 8066 OV **Development of capacitive RF MEMS switches with TaN and Ta<sub>2</sub>O<sub>5</sub> thin films** [8066-30]  
A. Persano, F. Quaranta, A. Cola, G. De Angelis, R. Marcelli, P. Siciliano, IMM-CNR, Institute for Microelectronics and Microsystems (Italy)
- 8066 OW **Effect of electro-thermo-mechanical coupling on the short-circuit in RF microswitch operation** [8066-31]  
E. Brusa, Politecnico di Torino (Italy); M. G. Munteanu, Univ. of Udine (Italy)
- 8066 OX **A reconfigurable impedance matching network entirely manufactured in RF-MEMS technology** [8066-32]  
J. Iannacci, Fondazione Bruno Kessler (Italy); D. Masotti, Univ. of Bologna (Italy); T. Kuenzig, M. Niessner, Munich Univ. of Technology (Germany)
- 8066 OY **Mechanical contact in system-level models of electrostatically actuated RF-MEMS switches: experimental analysis and modeling** [8066-33]  
M. Niessner, Munich Univ. of Technology (Germany); J. Iannacci, Fondazione Bruno Kessler (Italy); G. Schrag, Munich Univ. of Technology (Germany)

---

## SESSION 7 MODELLING

---

- 8066 OZ **Modeling of gold microbeams for characterizing MEMS packages** [8066-34]  
A. Faes, A. Repchankova, F. Solazzi, B. Margesin, Fondazione Bruno Kessler (Italy)
- 8066 10 **Hardware implementation of an electrostatic MEMS-actuator linearization** [8066-35]  
F. Mair, M. Egretzberger, A. Kugi, Vienna Univ. of Technology (Austria)
- 8066 11 **Vibration energy harvester optimization using artificial intelligence** [8066-63]  
Z. Hadas, C. Ondrusek, J. Kurfurst, V. Singule, Brno Univ. of Technology (Czech Republic)
- 8066 12 **Modeling and analysis of a micromachined piezoelectric energy harvester stimulated by ambient random vibrations** [8066-38]  
A. B. Alamin Dow, H. A. Al-Rubaye, D. Koo, Univ. of Toronto (Canada); M. Schneider, A. Bittner, U. Schmid, Vienna Univ. of Technology (Austria); N. P. Kherani, Univ. of Toronto (Canada)

---

**SESSION 8 ENERGY SCAVENGERS**

---

- 8066 14 **Modeling and characterization of a circular-shaped energy scavenger in MEMS surface micromachining technology** [8066-40]  
F. Solazzi, J. Iannacci, A. Faes, F. Giacomozzi, B. Margesin, Fondazione Bruno Kessler (Italy); A. Tazzoli, Univ. of Padova (Italy), IUNET (Italy), and Univ. of Pennsylvania (United States); G. Meneghesso, Univ. of Padova (Italy) and IUNET (Italy)
- 8066 15 **Issues in validation of performances of piezoelectric vibration-based energy harvesters** [8066-41]  
S. Zelenika, D. Blažević, Univ. of Rijeka (Croatia)
- 8066 16 **Plucked piezoelectric bimorphs for energy harvesting applications** [8066-42]  
M. Pozzi, M. Zhu, Cranfield Univ. (United Kingdom)
- 8066 17 **A novel MEMS design of a piezoelectric generator for fluid-actuated energy conversion** [8066-43]  
I. Kuehne, M. Schreiter, Siemens AG (Germany); J. Seidel, Munich Univ. of Applied Sciences (Germany); H. Seidel, Saarland Univ. (Germany); A. Frey, Siemens AG (Germany)
- 8066 18 **Piezoelectric power generation for sensor applications: design of a battery-less wireless tire pressure sensor** [8066-44]  
N. Makki, R. Pop-Iliev, Univ. of Ontario Institute of Technology (Canada)
- 8066 19 **Smart energy management and low-power design of sensor and actuator nodes on algorithmic level for self-powered sensorial materials and robotics** [8066-45]  
S. Bosse, T. Behrmann, Univ. of Bremen (Germany)

---

**POSTER SESSION**

---

- 8066 1A **Resonant piezoelectric AIN-actuated microcantilevers for detection of antigen/antibody interactions** [8066-14]  
M. J. Oliver, J. Hernando-García, Univ. de Castilla-La Mancha (Spain); A. Ababneh, Yarmouk Univ. (Jordan); H. Seidel, Saarland Univ. (Germany); U. Schmid, Technische Univ. Wien (Austria); J. Olivares, E. Iborra, Univ. Politécnica de Madrid (Spain); P. Pobedinskas, K. Haenen, Univ. Hasselt (Belgium); J. L. Sánchez-Rojas, Univ. de Castilla-La Mancha (Spain)
- 8066 1B **Energy harvesting circuit for sensor system power supply** [8066-46]  
P. Fiala, P. Drexler, Brno Univ. of Technology (Czech Republic)
- 8066 1D **Gold-based thin multilayers for ohmic contacts in RF-MEMS switches** [8066-48]  
V. Mulloni, J. Iannacci, R. Bartali, V. Micheli, S. Colpo, N. Laidani, B. Margesin, Fondazione Bruno Kessler (Italy)
- 8066 1E **AIN-based piezoelectric bimorph microgenerator utilizing low-level non-resonant excitation** [8066-50]  
S. Hampl, Ilmenau Univ. of Technology (Germany); V. Cimalla, Fraunhofer Institute for Applied Solid State Physics (Germany); T. Polster, M. Hoffmann, Ilmenau Univ. of Technology (Germany)

- 8066 1F **Airborne particle generation for optical tweezers by thermo-mechanical membrane actuators** [8066-51]  
T. Polster, S. Leopold, M. Hoffmann, Ilmenau Univ. of Technology (Germany)
- 8066 1G **Characterization of the first in-plane mode of AlN-actuated microcantilevers** [8066-52]  
V. Ruiz, J. Hernando-García, Univ. de Castilla-La Mancha (Spain); A. Ababneh, Yarmouk Univ. (Jordan); H. Seidel, Univ. des Saarlandes (Germany); U. Schmid, Vienna Univ. of Technology (Austria); J. K. Gimzewski, Univ. of California, Los Angeles (United States); J. L. Sánchez-Rojas, Univ. de Castilla-La Mancha (Spain)
- 8066 1H **Growth and characterization of uniform ZnO films as piezoelectric materials using a hydrothermal growth technique** [8066-53]  
E. Makarona, C. Fritz, G. Niarchos, T. Speliotis, National Ctr. for Scientific Research Demokritos (Greece); A. Arapoyanni, National and Kapodistrian Univ. of Athens (Greece); C. Tsamis, National Ctr. for Scientific Research Demokritos (Greece)
- 8066 1I **Piezoelectric AlN-actuated micro-tuning forks for sensing applications** [8066-54]  
M. Gil, T. Manzaneque, J. Hernando-García, Univ. de Castilla-La Mancha (Spain); A. Ababneh, Yarmouk Univ. (Jordan); H. Seidel, Saarland Univ. (Germany); J. L. Sánchez-Rojas, Univ. de Castilla-La Mancha (Spain)
- 8066 1J **Improved load-deflection method for the extraction of elastomechanical properties of circularly shaped thin-film diaphragms** [8066-55]  
J. Schalko, R. Beigelbeck, M. Stiffer, Institute for Integrated Sensor Systems (Austria); M. Schneider, A. Bittner, U. Schmid, Vienna Univ. of Technology (Austria)
- 8066 1K **The impact of substrate properties on the electromigration resistance of sputter-deposited Cu thin films** [8066-56]  
A. Bittner, N. Pagel, H. Seidel, Saarland Univ. (Germany); U. Schmid, Vienna Univ. of Technology (Austria)
- 8066 1L **Microfabricated self-resonant structure as a passive wireless chemical sensor** [8066-57]  
S. Zhang, P. Pasupathy, D. P. Neikirk, The Univ. of Texas at Austin (United States)
- 8066 1M **In incubator live cell imaging platform** [8066-58]  
N. Moscelli, Vienna Univ. of Technology (Austria); W. Witariski, Institute of Virology (Slovakia); S. van den Driesche, M. J. Vellekoop, Vienna Univ. of Technology (Austria)
- 8066 1N **Analytical investigation of the pull-in voltage in capacitive mechanical sensors** [8066-59]  
J. Lardiès, M. Berthillier, F. M. L. Bellaredj, Univ. of Franche-Comté (France)
- 8066 1O **Biomimetic MEMS to assist, enhance, and expand human sensory perceptions: a survey on state-of-the-art developments** [8066-60]  
T. Makarczuk, Vienna Univ. of Technology (Austria); T. R. Matin, Univ. Kebangsaan Malaysia (Malaysia); S. B. Karman, Univ. Kebangsaan Malaysia (Malaysia) and Univ. of Malaya (Malaysia); S. Z. M. Diah, B. Davaji, Univ. Kebangsaan Malaysia (Malaysia); M. O. Macqueen, Aramis Technologies (Malaysia); J. Mueller, trustroom (Austria); U. Schmid, Vienna Univ. of Technology (Austria); I. C. Gebeshuber, Vienna Univ. of Technology (Austria) and Univ. of Kebangsaan Malaya (Malaysia)



- 8066 1P **System modeling of a piezoelectric energy harvesting module for environments with high dynamic forces** [8066-61]  
A. Frey, Siemens AG (Germany); J. Seidel, Munich Univ. of Applied Sciences (Germany); M. Schreiter, I. Kuehne, Siemens AG (Germany)
- 8066 1Q **3D capacitive vibrational micro harvester using isotropic charging of electrets deposited on vertical sidewalls** [8066-62]  
A. Nimo, U. Mescheder, B. Müller, A. Saad Abou Elkeir, Hochschule Furtwangen Univ. (Germany)
- 8066 1R **THz detection by modified thermopile** [8066-64]  
B. Szentpáli, Research Institute for Technical Physics and Materials Science (Hungary); G. Matyi, EnerSys Advanced Systems (Hungary); P. Fürjes, E. László, G. Battistig, I. Bársony, Research Institute for Technical Physics and Materials Science (Hungary); G. Károlyi, T. Bercei, Budapest Univ. of Technology and Economics (Hungary)
- 8066 1S **Microfabricated ultrashort cantilever probes for high speed AFM** [8066-65]  
C. Richter, P. Weinzierl, O. Krause, W. Engl, Nanoworld Services GmbH (Germany); C. Penzkofer, B. Imer, nanotools GmbH (Germany); T. Sulzbach, Nanoworld Services GmbH (Germany)
- 8066 1T **Tactile refreshable screen based on magneto-rheological fluids for map exploration and navigation tasks** [8066-66]  
C. Bolzmacher, G. Changeon, V. Plaud, S. Roselier, J. Lozada, M. Hafez, CEA LIST (France)
- 8066 1U **Robust pressure sensor for measurements in boundary layers of liquid fluids with medium total pressures** [8066-67]  
T. Beutel, N. Ferreira, M. Leester-Schädel, S. Büttgenbach, Technische Univ. Braunschweig (Germany)
- 8066 1V **Non-electrical-power temperature-time integrating sensor for RFID based on micro fluidics** [8066-68]  
M. Schneider, M. Hoffmann, Ilmenau Univ. of Technology (Germany)
- 8066 1W **Investigation on micromachining technologies for the realization of LTCC devices and systems** [8066-69]  
T. Haas, C. Zeilmann, Micro Systems Engineering GmbH (Germany); A. Bittner, U. Schmid, Vienna Univ. of Technology (Austria)
- 8066 1X **IR thermocycler for centrifugal microfluidic platform with direct on-disk wireless temperature measurement system** [8066-70]  
J. Burger, A. Gross, Univ. of Freiburg (Germany); D. Mark, HSG-IMIT (Germany); G. Roth, Univ. of Freiburg (Germany); F. von Stetten, R. Zengerle, Univ. of Freiburg (Germany) and HSG-IMIT (Germany)
- 8066 1Y **Optical fiber waveguide sensor for the colorimetric detection of ammonia** [8066-72]  
K. Schmitt, J. Rist, C. Peter, Fraunhofer Institute for Physical Measurement Techniques (Germany); J. Wöllenstein, Fraunhofer Institute for Physical Measurement Techniques (Germany) and Univ. of Freiburg (Germany)

- 8066 17 **A liquid properties sensor utilizing pressure waves** [8066-73]  
H. Antlinger, Johannes Kepler Univ. Linz (Austria); R. Beigelbeck, Institute for Integrated Sensor Systems (Austria); S. Clara, Johannes Kepler Univ. Linz (Austria); S. Cerimovic, F. Keplinger, Vienna Univ. of Technology (Austria); B. Jakoby, Johannes Kepler Univ. Linz (Austria)
- 8066 20 **Non-contact volume determination of free flying nanoliter droplets using an adjustable capacitive measurement bridge** [8066-74]  
A. Ernst, Univ. of Freiburg (Germany) and Biofluidix GmbH (Germany); B. Vondenbusch, Hochschule Furtwangen Univ. (Germany); R. Zengerle, Univ. of Freiburg (Germany); P. Koltay, Univ. of Freiburg (Germany) and Biofluidix GmbH (Germany)
- 8066 21 **Microelectro discharge machining: an innovative method for the fabrication of 3D microdevices** [8066-75]  
C. Lesche, T. Krahn, S. Büttgenbach, Technische Univ. Braunschweig (Germany)
- 8066 22 **Wafer bonding for MEMS and CMOS integration** [8066-77]  
V. Dragoi, EV Group (Austria); E. Pabo, EV Group Inc. (United States); J. Burggraf, G. Mittendorfer, EV Group (Austria)
- 8066 23 **Use of self-sensing piezoresistive Si cantilever sensor for determining carbon nanoparticle mass** [8066-78]  
H. S. Wasisto, S. Merzsch, A. Stranz, A. Waag, Braunschweig Univ. of Technology (Germany); E. Uhde, I. Kirsch, T. Salthammer, Fraunhofer-Institute of Wood Research, Wilhelm-Klauditz-Institut (Germany); E. Peiner, Braunschweig Univ. of Technology (Germany)
- 8066 24 **Experimental setup for the coating of chlorosilane-based self-assembling monolayers to reduce stiction in MEMS devices** [8066-79]  
H. Steiner, M. Sachse, Institute for Integrated Sensor Systems (Austria); J. Schalko, Institute for Integrated Sensor Systems (Austria) and Vienna Univ. of Technology (Austria); W. Hortschitz, F. Kohl, Institute for Integrated Sensor Systems (Austria); A. Jachimowicz, Vienna Univ. of Technology (Austria)
- 8066 25 **Impedance spectroscopy on a digital microfluidic platform** [8066-80]  
T. Lederer, S. Clara, B. Jakoby, W. Hilber, Johannes Kepler Univ. Linz (Austria)
- 8066 26 **A comb-drive scanning-head array for fast scanning-probe microscope measurements** [8066-82]  
S. Gao, H. Wolff, K. Herrmann, U. Brand, Physikalisch-Technische Bundesanstalt (Germany); K. Hiller, S. Hahn, A. Sorger, J. Mehner, Chemnitz Univ. of Technology (Germany)
- 8066 27 **A MEMS-based thermal infrared emitter for an integrated NDIR spectrometer** [8066-83]  
C. Calaza, M. Salleras, N. Sabaté, J. Santander, C. Cané, L. Fonseca, Instituto de Microelectrónica de Barcelona (Spain)
- 8066 28 **Flexible and large area pressure sensors for human-neuroprostheses and human-neurobotic interface assessment** [8066-84]  
J. Herrán, I. Fernández, E. Ochoteco, G. Cabañero, H. Grande, CIDETEC (Spain); J. L. Pons, CSIC (Spain)

- 8066 29 **A study on tunable resonators for rheological measurements** [8066-85]  
M. Heinisch, Johannes Kepler Univ. Linz (Austria); E. K. Reichel, Katholieke Univ. Leuven (Belgium); B. Jakoby, Johannes Kepler Univ. Linz (Austria)
- 8066 2A **Binary zero-power sensors: an alternative solution for power-free energy-autonomous sensor systems** [8066-86]  
T. Frank, CiS Forschungsinstitut für Mikrosensorik und Photovoltaik GmbH (Germany); G. Gerlach, Technische Univ. Dresden (Germany); A. Steinke, CiS Forschungsinstitut für Mikrosensorik und Photovoltaik GmbH (Germany)
- 8066 2B **Fabrication technologies for the electrode structure of a dielectric elastomer bending tube actuator** [8066-87]  
F. Wehrheim, Richard Wolf GmbH (Germany); H. F. Schlaak, Technische Univ. Darmstadt (Germany)
- 8066 2C **Evaluation of sensor arrays for engine oils using artificial oil alteration** [8066-88]  
S. Sen, AC<sup>2</sup>T Research GmbH (Austria) and Vienna Univ. of Technology (Austria); C. Schneidhofer, N. Dörr, AC<sup>2</sup>T Research GmbH (Austria); M. J. Vellekoop, Vienna Univ. of Technology (Austria)
- 8066 2E **Viscosity and density measurements of glycerol-water mixtures utilizing a novel resonant MEMS sensor** [8066-90]  
S. Cerimovic, Vienna Univ. of Technology (Austria); R. Beigelbeck, Institute for Integrated Sensor Systems (Austria); H. Antlinger, Johannes Kepler Univ. Linz (Austria); J. Schalko, Vienna Univ. of Technology (Austria) and Institute for Integrated Sensor Systems (Austria); B. Jakoby, Johannes Kepler Univ. Linz (Austria); F. Keplinger, Vienna Univ. of Technology (Austria)
- 8066 2F **Fabrication and characterization of artificial hair cell sensor based on MWCNT-PDMS composite** [8066-91]  
C. Y. Kim, Pohang Univ. of Science and Technology (Korea, Republic of); H. S. Lee, Samsung Electronics Co., Ltd. (Korea, Republic of); Y. H. Cho, C. Joh, Agency for Defense Development (Korea, Republic of); P. Choi, Pohang Univ. of Science and Technology (Korea, Republic of) and Kyungpook National Univ. (Korea, Republic of); S. J. Park, Pohang Univ. of Science and Technology (Korea, Republic of)
- 8066 2G **Comparison among performance of strain sensors based on different semiconductor thin films** [8066-92]  
M. A. Fraga, Instituto de Estudos Avançados (Brazil) and Instituto Tecnológico de Aeronáutica (Brazil); H. Furlan, Faculdade de Tecnologia de São Paulo (Brazil); R. S. Pessoa, Instituto Tecnológico de Aeronáutica (Brazil)
- 8066 2H **Polyimide/PDMS flexible thermoelectric generator for ambient assisted living applications** [8066-93]  
L. Francioso, C. De Pascali, I. Farella, C. Martucci, P. Cretì, P. Siciliano, CNR-IMM (Italy)
- 8066 2I **Nanostructured silicon for thermoelectric** [8066-94]  
A. Stranz, J. Köhler, A. Waag, E. Peiner, Technische Univ. Braunschweig (Germany)

- 8066 2J **Variable isotropy Deep RIE process for through wafer via holes manufacturing** [8066-95]  
D. Vasilache, FBK-irst (Italy) and National Research and Development Institute in Microtechnology (Romania); S. Colpo, F. Giacomozzi, S. Ronchin, A. Q. A. Qureshi, B. Margesin, FBK-irst (Italy)
- 8066 2K **Development of a new technological MEMS process for AC voltage standards** [8066-96]  
F. Blard, Lab. National de Métrologie et d'Essais (France), Lab. d'Analyse et d'Architecture des Systèmes, CNRS (France), and Univ. of Toulouse (France); A. Bounouh, D. Bélières, Lab. National de Métrologie et d'Essais (France); S. Charlot, D. Bourrier, H. Camon, Lab. d'Analyse et d'Architecture des Systèmes, CNRS (France) and Univ. of Toulouse (France)
- 8066 2L **Hysteresis correction of tactile sensor response with a generalized Prandtl-Ishlinskii model** [8066-97]  
J. A. Sánchez-Durán, Ó. Oballe-Peinado, J. Castellanos-Ramos, F. Vidal-Verdú, Univ. of Málaga (Spain)

*Author Index*

# Conference Committee

## *Symposium Chair*

**Thomas Becker**, EADS Innovation Works (Germany)

## *Symposium Cochairs*

**José Feliciano López**, Universidad de Las Palmas de Gran Canaria  
(Spain)

**Gerhard Krötz**, Hochschule Kempten (Germany)

## *Symposium Local Chair*

**Cestmír Ondrůšek**, Technical University of Brno (Czech Republic)

## *Conference Chair*

**Ulrich Schmid**, Technische Universität Wien (Austria)

## *Conference Cochairs*

**José Luis Sánchez-Rojas**, Universidad de Castilla-La Mancha (Spain)

**Monika Leester-Schaedel**, Technische Universität Braunschweig  
(Germany)

## *Programme Committee*

**Abdallah Ababneh**, Yarmouk University (Jordan)

**Eduard Arzt**, Leibniz-Institut für Neue Materialien GmbH (Germany)

**Fred Barlow**, University of Idaho (United States)

**Joan Bausells**, Centro Nacional de Microelectrónica (Spain)

**Christian H. Bolzmacher**, Commissariat à l'Energie Atomique (France)

**Carles Cané**, Centro Nacional de Microelectrónica (Spain)

**Viorel Dragoi**, EV Group (Austria)

**Guido Faglia**, Università degli Studi di Brescia (Italy)

**Georg E. Fantner**, École Polytechnique Fédérale de Lausanne  
(Switzerland)

**Carles Ferrer Ramis**, Universitat Autònoma de Barcelona (Spain)

**Pavel J. Fiala**, Brno University of Technology (Czech Republic)

**Maximilian Fleischer**, Siemens AG (Germany)

**Alois Friedberger**, EADS Deutschland GmbH (Germany)

**Friedrich Franek**, AC²T Research GmbH (Austria)

**Sören Fricke**, Robert Bosch AG (Switzerland)

**Katia M. Grenier**, Laboratoire d'Analyse et d'Architecture des Systèmes, CNRS (France)  
**Moustapha Hafez**, Commissariat à l'Énergie Atomique (France)  
**Arno C. Hoogerwerf**, Centre Suisse d'Electronique et de Microtechnique SA (Switzerland)  
**Jacopo Iannacci**, Fondazione Bruno Kessler (Italy)  
**Enrique Iborra**, Universidad Politécnica de Madrid (Spain)  
**Bernhard Jakoby**, Johannes Kepler Universität Linz (Austria)  
**Konrad Kapser**, Infineon Technologies AG (Germany)  
**Tom Kazmierski**, University of Southampton (United Kingdom)  
**Roy Knechtel**, X-FAB Semiconductor Foundries AG (Germany)  
**Andreas Kugi**, Technische Universität Wien (Austria)  
**Robert J. Lad**, University of Maine (United States)  
**Jeong-Bong Lee**, The University of Texas at Dallas (United States)  
**Dean P. Neikirk**, The University of Texas at Austin (United States)  
**Sergio P. Pacheco**, Freescale Semiconductor, Inc. (United States)  
**Erwin Peiner**, Technische Universität Braunschweig (Germany)  
**Gabriele Schrag**, Technische Universität München (Germany)  
**Andreas Schütze**, Universität des Saarlandes (Germany)  
**Pietro Siciliano**, Istituto per la Microelettronica e Microsistemi, CNR (Italy)  
**Anita Lloyd Spetz**, Linköping Universitet (Sweden)  
**Christos Tsamis**, National Centre for Scientific Research Demokritos (Greece)  
**Michael J. Vellekoop**, Technische Universität Wien (Austria)  
**Jürgen Wöllenstein**, Fraunhofer-Institut für Physikalische Messtechnik (Germany)  
**Roland Zengerle**, Albert-Ludwigs-Universität Freiburg (Germany)

### *Session Chairs*

- 1 High Temperature Sensors  
**Ulrich Schmid**, Technische Universität Wien (Austria)  
**Pietro Siciliano**, Istituto per la Microelettronica e Microsistemi, CNR (Italy)
- 2 Materials  
**José Luis Sánchez-Rojas**, Universidad de Castilla-La Mancha (Spain)  
**Achim Bittner**, Technische Universität Wien (Austria)
- 3 Bio-MEMS  
**Jeong-Bong Lee**, The University of Texas at Dallas (United States)  
**Dean P. Neikirk**, The University of Texas at Austin (United States)
- 4 Gas Sensors  
**Alois Friedberger**, EADS Deutschland GmbH (Germany)  
**Robert J. Lad**, University of Maine (United States)

- 5 Optical Devices and Systems  
**Pavel J. Fiala**, Brno University of Technology (Czech Republic)  
**Jacopo Iannacci**, Fondazione Bruno Kessler (Italy)
- 6 High-Frequency MEMS  
**Monika Leester-Schaedel**, Technische Universität Braunschweig  
(Germany)  
**Bernhard Jakoby**, Johannes Kepler Universität Linz (Austria)
- 7 Modelling  
**Gabriele Schrag**, Technische Universität München (Germany)  
**Jürgen Wöllenstein**, Fraunhofer-Institut für Physikalische Messtechnik  
(Germany)
- 8 Energy Scavengers  
**Christos Tsamis**, National Centre for Scientific Research Demokritos  
(Greece)  
**Erwin Peiner**, Technische Universität Braunschweig (Germany)





## Introduction

The Smart Sensors, Actuators, and MEMS conference took place in Prague, Czech Republic 18–20 April 2011. Almost 100 contributions from Europe, America, and Asia were accepted and grouped into 9 sessions including a poster session. The interdisciplinary spirit of the event was displayed by a wide range of topics based on the latest results achieved in the research and development areas of precision engineering and MEMS. Therefore sessions focused on material and fabrication aspects, on micromachined sensors and actuators for the determination of biological, physical, and chemical quantities, as well as on reliability issues. Moreover, optical and RF MEMS were presented and more application-oriented topics such as energy scavengers, microfluidic systems, and low power management systems were discussed. This broad range of topics, plus researchers coming from academia and industry with their specific backgrounds, created a very stimulating atmosphere for the exchange of new ideas.

Besides the high quality of the oral and poster presentations, I would like to highlight the three invited talks: Omar Elmazria from CNRS-Nancy University, France, on “Materials and device-related aspects for the high temperature operation of SAW sensor elements” (806602); by Andreu Llobera, Centro Nacional de Microelectrónica, Spain, on photonic microreactors and their application in real-time cell screening (80660D); and last, but not least, by Gunilla Wingqvist, Linköping University, Sweden, on piezoelectric sensor elements operated in liquid media and excited by pure or modified aluminium nitride thin films (80660U).

I would like to thank all participants for their individual contributions which made the conference a successful event in the international conference calendar.

Special thanks go to José Feliciano López, Gerhard Krötz, and Thomas Becker for organising the symposium, the SPIE staff, and to my cochairs José Luis Sánchez de Rojas Aldavero (Univ. Castilla-La Mancha, Ciudad Real, Spain) and Monika Leester-Schaedel (Technische Universität Braunschweig, Germany). Finally I would like to thank the programme committee for doing the reviews and acting partly as session chairs.

**Ulrich Schmid**  
**José Luis Sánchez-Rojas**  
**Monika Leester-Schaedel**

