

9th International Conference and Exhibition on Integration Issues of Miniaturized Systems 2015

Copenhagen, Denmark
11 – 12 March 2015

ISBN: 978-1-5108-2361-7

Printed from e-media with permission by:

Curran Associates, Inc.
57 Morehouse Lane
Red Hook, NY 12571



Some format issues inherent in the e-media version may also appear in this print version.

Copyright© (2015) by Mesago PCIM GmbH
All rights reserved.

Printed by Curran Associates, Inc. (2016)

For permission requests, please contact Mesago PCIM GmbH
at the address below.

Mesago PCIM GmbH
Rotebuehlstrasse 83-85
70178 Stuttgart Germany

Phone: 49 711 619 460
Fax: 49 711 619 4690

info@mesago.com

Additional copies of this publication are available from:

Curran Associates, Inc.
57 Morehouse Lane
Red Hook, NY 12571 USA
Phone: 845-758-0400
Fax: 845-758-2634
Email: curran@proceedings.com
Web: www.proceedings.com

Table of contents

Conference Sessions

Session I: Manufacturing of smart systems

BMA355 – driving miniaturization beyond the plastic package 2

Heiko Stahl, Marcus Schuster, Ralf Reichenbach, Robert Bosch GmbH, DE

Rapid Prototyping of 3D electrically conducting structures 10

Roberto Pacios, Ikerne Etxebarria, Jorge Elizalde, Aitor Ezkerra, IKERLAN-IK4, ES

High Performance Silicon Membrane Etching in Volume Production N/A

Uwe Schwarz, X-FAB MEMS Foundry GmbH, DE

Trends in the manufacturing of miniaturized microelectronics circuits for active implantable medical devices 18

Renzo Dal Molin, SORIN CRM, FR

Session II: Test and reliability

HALT corrosion testing of wearable electronics 25

Susanne Otto, DELTA Danish Electronics, Light & Acoustics, DK

Diffusion Barrier Stability against Cu Diffusion under the Influence of Heavy Cu Wire Bonding 32

David Gross, Sabine Haag, Robert Bosch GmbH, DE

Martin Schneider-Ramelow, Fraunhofer Institute for Reliability and Microintegration IZM, DE

Klaus-Dieter Lang, Technische Universität Berlin, DE

Mechanical stress induced in Si sensors during bonding and packaging processes 40

Florian Rost, Florian Schindler-Saefkow, Dietmar Vogel, Bernd Michel, Sven Rzepka, Fraunhofer Institute for Electric Nano Systems ENAS, DE

Jörg Schaufuß, Jan Mehner, Technische Universität Chemnitz, DE

RFID-Based Chain Drag Measurement System (CDMS) for the Stress-Based Control of Industrial Chain Drives 48

Nico Feller, Ulf Müller, Sebastian Trampnau, Julia Stürznickel, Fabian Lusztyk, Cologne University of Applied Sciences, DE

Session III: Design of smart systems

Model-based Design of MEMS Far Infrared Thermal Imagers 57

Fabian Utermoehlen, Ingo Herrmann, Robert Bosch GmbH, DE

Joachim N. Burghartz, Institut für Mikroelektronik Stuttgart, DE

High Level Modelling and Simulation of a Sensor System for Trace Detection of Different Molecules in the Air 65

Prof. Drago Strle, University of Ljubljana, SL

Igor Muševič, IJS, SL

PDK-based design automation enablement for a surface-micromachined capacitive MEMS foundry process 73

Jörg Doblaski, X-FAB Semiconductor Foundries AG, DE

Panel Discussion

“Towards a “Lego brick principle” for heterogeneous system design including MEMS and electronics – Choose and put together- fit?” 81

Dr. Reinhard Neul, Tobias Maier, Robert Bosch GmbH, DE
Anssi Blomqvist, Murata Electronics Oy, FI
Gunar Lorenz, Coventor, FR
Mirco Meiners, University of Applied Sciences Bremen, DE
Peter Merz, X-FAB MEMS Foundry GmbH, DE
Ahmed Hussein Osman, Cadence Design Systems, DE
Ralf Sommer, IMMS Institute for Microelectronics- and Mechatronic-Systems, DE

Session IV: System integration and packaging I

Self-assembly of micro- and nano-particles by centrifugal forces and capillary bridging for 3D thermal interconnects 85

Christian Hofmann, Mario Baum, Florian Bodny, Maik Wiemer, Thomas Gessner, Fraunhofer Institute for Electric Nano Systems ENAS, DE
Thomas Brunschweiler, Jonas Zürcher, Brian R. Burg, IBM Research, CH
Severin Zimmermann, ETH Zurich, CH

Flexible packaging by film assisted molding for micro assembly technologies based on PCB 93

Daniel Hera, T. Günther, K.-P. Fritz, H. Kück, A. Zimmermann, HSG-IMAT e.V., DE
A. Berndt, C. Harendt, J.-D. Schulze Spüntrup, C. Reuter, IMS Chips Institut für Mikroelektronik, DE

Advanced 2.5D PCB Based MEMS Package 101

Martin Lenzhofer, Andreas Tortschanoff, CTR Carinthian Tech Research AG, AT

Integrated sensor systems realized with 3D-MID 107

Dr. Ellen McMillan, Frank Wittwer, Harting AG, CH
Dr. Christian Goth, Continental AG, DE

Development of Solder Paste Jetting Processes for Advanced Packaging 112

K.-F. Becker, P. Reiners, M. Koch, J. Bauer, T. Braun, Fraunhofer Institute for Reliability and Microintegration IZM, DE
T. Thomas, S. Voges, K.-D. Lang, Technische Universität Berlin, DE
M. Fliess, Vermes Microdispensing GmbH, DE

Session V: Printing technologies for smart systems

Roadmap for organic and printed electronics 125

Dr. Klaus Hecker, Sven Breitung, OE-A Organic and Printed Electronics Association, DE
Wolfgang Clemens, PolyIC GmbH & Co. KG, DE
Donald Lupo, Tampere University of Technology, FI

Inkjet printing as a tool for function integration in microfluidic lab-on-a-chip systems 127

Oliver Pabst, Erik Beckert, Ramona Eberhardt, Andreas Tünnermann, Fraunhofer Institute for Applied Optics and Precision Engineering IOF, DE

An inkjet adaptive backend strategy for low-yield OTFT digital circuits 135

Dr. Eloi Ramon, Institut de Microelectrónica de Barcelona IMB-CNM (CSIC), ES
Enrico Sowade, Kalyan Yoti Mitra, Reinhard R. Baumann, Technische Universität Chemnitz, DE

Printing of conductive patterns for application in smart lightweight structures 140

Melinda Hartwig, Markus Gaitzsch, Michael Heinrich, Toni D. Großmann, Lothar Kroll,
Thomas Gessner, Reinhard R. Baumann, Technische Universität Chemnitz, DE

Session VI: System integration and packaging II

Harvesting a few μW 's is enough 149

René Elfrink, P. Bembnowicz, M. Tutelaers, S. Stanzione, V. van Acht,, R. van Schaijk, imec / Holst Centre,
NL
M. Nabeto, D. Uchida, OMRON, JP

A Smart Air Quality Monitor for Energy Efficient Buildings 157

Emily Hammes, Helmut F. Knapp, CSEM - Center Central Switzerland, CH
Jurgi Gonzalez-Chavarri, Gemma Garcia Mandayo, CEIT, ES
Liam Henwood-Moroney, Gooch & Housego, UK
Peter Ryser, EPFL, CH

'nCapsulate' freeform packaging 165

Oliver Maiwald, Ignas van Dommelen, Sencio B.V., NL

Investigation of Room-Temperature Flip Chip Connections 170

Morten Brink, Arian Grams, Yann Eichhammer, Marian Broll, Thomas Fritsch, Fraunhofer Institute for
Reliability and Microintegration IZM, DE
Klaus-Dieter Lang, Technische Universität Berlin, DE

Session VII: Perspectives of smart systems

Strategic approach to System Integration, Interoperability & Standardisation 179

Walter Huck, Murata Elektronik GmbH, DE

Built-in Security to enable multifunctional Connected Smart Systems 184

Bernard Candaele, Thales, FR

Industry 4.0 - Cross-cluster activities between microsystems technology, IT and virtual engineering 188

Dr. Klaus Funk, Amin Njah, Christine Neuy, Peter-Josef Jeuk, Mikrosystemtechnik
Baden-Württemberg, DE

Competence mapping of the 4M project cluster advanced manufacturing of multi-material, multi-functional products 195

Dr. Susan Anson, Adrien Brunet, Andreas Schmidt, Karlsruher Institut für
Technologie (KIT), DE
Stefan Dimov, University of Birmingham, UK
David Gardner, CTECH Innovation, UK
Jerome Gavillet, CEA-LITEN, Grenoble, FR

Session VIII: Components for smart systems

Maximizing the Internet of Everything by Mobilizing the MEMS/Sensors and Adjacent Ecosystems N/A

Karen Lightman, MEMS Industry Group, US

Electrically tunable Fabry-Pérot interferometer with inherent compensation of the influence of gravitation and vibration 204

Marco Meinig, Steffen Kurth, Thomas Gessner, Fraunhofer Institute for Electric Nano Systems ENAS, DE
Christian Helke, Mario Seifert, Karla Hiller, Technische Universität Chemnitz, Zentrum für Mikrotechnologien, DE
Martin Ebermann, Norbert Neumann, InfraTec GmbH, DE

Ultra-low power integrated microsystems 212

Dr. Philippe Laurent, MICROSYS University of Liege, BE
F. Dupont, S. Stoukatch, F. Axisa, University of Liege, BE

Porous Silicon Based On-Chip Supercapacitors N/A

Dr. Mika Prunnila, VTT Technical Research Centre of Finland, FI

Carbon Nanotube based sensors in MEMS/NEMS 221

Dr. Sascha Hermann, S. Böttger, S. Hartmann, A. Shaporin, J. Mehner, B. Wunderle, S. Schulz, Technische Universität Chemnitz, DE
J. Bonitz, T. Gessner, Fraunhofer Institute for Electric Nano Systems ENAS, DE

Session IX: Micro and nano technologies and materials

Novel ultra-sonic MEMS sensor for spark detection in Li-ion batteries 224

Hélène Lhermet, Jaroslaw Czarny, Thierry Verdot, Pierre Perichon, Philippe Robert, Brigitte Desloges, Audrey Berthelot, CEA-Léti, FR
Emmanuel Redon, Jean-Louis Guyader, LVA-Insa Lyon, FR

Dual-mode probe for ultrasonic imaging and therapy based on cMUT technology 232

Bruno Fain, Dr. Caroline Coutier, C. Dressler, CEA-Léti, FR
M. Legros, FR
D. Gross, A. Bouakaz, Ph. Vince, D. Certon, Université François Rabelais de Tours, FR

Evaluation of sputtered Pd76Cu6Si18 metallic glass for MEMS application 240

Klaus Vogel, Maik Wiemer, Thomas Gessner, Fraunhofer Institute for Electric Nano Systems ENAS, DE
Juergen Vogel, Westsächsische Hochschule Zwickau, DE
Yu-Ching Lin, Yao-Chuan Tsai, Masayoshi Esashi, Takashiro Tsukamoto, Shuji Tanaka, Tohoku University, JP

Microbubble optical resonators as integrated sensing systems 248

Dr. Giancarlo Righini, Francesco Baldini, Simone Berneschi, Alessandro Cosci, Franco Cosi, Daniele Farnesi, Ambra Giannetti, Sara Tombelli, Cosimo Trono, Gualtiero Nunzi Conti, Stefano Pelli, Silvia Soria, CNR National Research Council, IT

Thermal Imaging Devices using Eu(TTA)3-based Infrared-to-Visible Conversion Thin Film Array 256

Dr. Takashiro Tsukamoto, Min Wang, Shuji Tanaka, Tohoku University, JP

Session X: Smart medtech systems

Micromachined cochlear implant 265

Prof. P. J. French, N. Lawand, L. Pakula, H. van Zeijl, Delft University of Technology, NL
JHM. Frijns, J. Braire, Leiden University Medical Centre, NL

Flexible and stretchable electronics for wearable health devices N/A
Dr. Jeroen van den Brand, Holst Centre, NL

Chemo-mechanical energy converter “Organic engine” for autonomous blood sugar control system in diabetes 273
Prof. Kohji Mitsubayashi, Munkhbayar Munkhjargal, Rei Sato, Yuki Matsuura, Kohdai Hatayama, Koji Toma, Takahiro Arakawa, Tokyo Medical and Dental University, JP

Characterisation and testing of a ‘smart’ needle 281
Lisa Helen, Eric Moore, Tyndall National Institute, IE
Brian O’Donnell, University College Cork, Cork, IE

High frequency ultrasonic matrix transducer for volumetric ultrafast Doppler imaging using through piezoceramic via interconnection 287
Martin Flesch, Guillaume Férin, An Nguyen-Dinh, Vermon, FR
Thomas Deffieux, Jean Provost, Mathieu Pernot, Mickael Tanter, ESPCI Paristech, FR

Session XI: Software for smart systems

From the Internet-of-Things to Sensor Clouds - Unified Distributed Computing in Heterogeneous Environments with Smart and Mobile Multi-Agent Systems 297
Stefan Bosse, Universität Bremen, DE

Safety-Critical Smart Systems with Software Coded Processing 306
Dr. Martin Süßkraut, Jörg Kaienburg, SIListra Systems GmbH, DE

SensIDL: Towards a generic framework for implementing sensor communication interfaces 314
Dr. Christoph Rathfelder, HSG-IMIT (Institut für Mikro- und Informationstechnik), DE
Emre Taspolatoglu, FZI Forschungszentrum Informatik am Karlsruher Institut für Technologie, DE

A software architecture for secure access to services in smart systems 320
Dr. Markus Pistauer, Michael Lafer, CISC Semiconductor GmbH, AT

Session XII: Smart energy systems

Low power smart systems for improved quality of life 324
Dr. Sywert Brongersma, Holst Centre, NL

Improving HV battery efficiency by smart control systems 325
Riccardo Groppo, Ideas & Motion s.r.l., IT
Eric Armengaud, Georg Macher, AVL List GmbH, AT
Can Kurtulus, AVL Research and Engineering, TR
Sven Haase, Chemnitzer Werkstoffmechanik GmbH, DE
Günter Hofer, Infineon Technologies Austria AG, AT
Claudio Lanciotti, Manz, IT
Alexander Otto, Fraunhofer Institute for Electric Nano Systems ENAS, DE
Holger Schmidt, Infineon Technologies AG, DE
Slawomir Stankiewicz, Impact Clean Power Technology SA, PL

Practical experience and results of an extensive pilot test of the ASTROSE® sensor network for high voltage power line monitoring 333
Sven Voigt, Steffen Kurth, Thomas Geßner, Fraunhofer Institute for Electric Nano Systems ENAS, DE
Michael Pfeiffer, MITNETZ STROM, DE
Benjamin Heibutzki, Technische Universität Chemnitz, DE
Carsten Brockmann, Volker Großner, Fraunhofer Institute for Reliability and Microintegration IZM, DE

Easy Energy Monitoring by IoT Enabling Existing Devices 341
Bo Eskerod Madsen, ReMoni, DK

Session XIII: Smart production

Emerging magnetic sensor technologies for condition monitoring and non-destructive testing 345
Dr. Rolf Slatter, Sensitec, DE

Miniaturized silicon strain gauge elements for various applications 355
Dr. Thomas Frank, Manoj Khatri, Manuel Fiedler, Andre Gruen, Manuel Kermann, Andrea Cyriax, CiS Forschungsinstitut f. Mikrosensorik und Photovoltaik GmbH, DE

Two-photon polymerization process unit for fabricating 3 - D structures with high resolution on wafer scale dimension 363
Eric Markweg, Thomas Kowallik, Joerg Maempel, Olaf Mollenhauer, TETRA Gesellschaft für Sensorik, Robotik und Automation mbH, DE

Energetic efficiency improvement of a stretch blow molding machine by means of a smart preform holder 367
María Tijero, Javier Berganzo, Iñigo Aramburu, IK4-Ikerlan, ES
Carlos Arbizu, Gurutz Galfarsoro, Urola S.C., ES

Poster Session

Secure integration of industrial components with authentication using OPC UA protocol 376
Alexander Borisov, Robert Bosch GmbH, DE

Mechanical Characterization of Poly-Silicon Membranes by Efficient Experimental Tests and Numerical Simulations 380
John Brückner, Ellen Auerswald, Dietmar Vogel, Rainer Dudek, Sven Rzepka, Fraunhofer Institute for Electric Nano Systems ENAS, DE
Alfons Dehé, Infineon Technologies, DE

Precision laser droplet soldering of components for Multi Shaped Beam Lithography 384
Thomas Burkhardt, Matthias Mohaupt, Ben Zaage, Erik Beckert, Ramona Eberhardt, Andreas Tünnermann, Fraunhofer Institute for Applied Optics and Precision Engineering IOF, DE
Hans-Joachim Döring, Vistec Electron Beam GmbH, DE

Fabrication of Micro Needle arrays using an Ultra short pulse Laser 388
Tom Enderlein, Jörg Nestler, Technische Universität Chemnitz, DE
Thomas Otto, Thomas Gessner, Fraunhofer Institute for Electric Nano Systems ENAS, DE

An Open Source Open Water Monitor 392
Emily Hammes, CH
Simon Schubert, DE

Fast and Accurate Event-Driven Simulation of a Mixed-Signal System Using the Example of a PLL 396
Christian Hedayat, Fraunhofer Institute for Electric Nano Systems ENAS, DE
Christian Hangmann, Ulrich Hilleringmann, Universität Paderborn, DE

- Performance investigation of UHF RFID tags designed for air and rubber belts - impact of electrical parameters and the shape of the belts** 402
C. Hedayat, V. Geneiss, T. Gessner, Fraunhofer Institute for Electric Nano Systems ENAS, DE
Kelash Kanwar, T. Mager, U. Hilleringmann, Universität Paderborn, DE
- Surface patterning and self-assembly of DNA-Origami based transistor nanoarchitectures** 410
Christian Helke, Jörg Nestler, Technische Universität Chemnitz, DE
Thomas Gessner, Fraunhofer Institute for Electric Nano Systems ENAS, DE
- Numerical Study of Plasmonic Nanostructures based on Au-Ag Alloy** 414
Dr. Vladimir Kolchuzhin, Jan E. Mehner, Raul D. Rodriguez, Dietrich R.T. Zahn, Technische Universität Chemnitz, DE
- Reactive nanocomposites for heterogeneous integration** 418
Matthias Kremer, Andreas Tortschanoff, CTR Carinthian Tech Research AG, AT
Andreas E. Guber, Karlsruher Institut für Technologie, DE
- Influence of different hole transport layers on the performance of Quantum Dot Light emitting diodes** 422
Jörn Langenickel, Technische Universität Chemnitz, DE
A. Weiß, J. Martin, T. Otto, T. Geßner, Fraunhofer Institute for Electric Nano Systems ENAS, DE
- Synthesis and characterization of nanogenerators based on doped zinc oxide** 426
Kathleen Heinrich, J. Martin, T. Otto, T. Geßner, Fraunhofer Institute for Electric Nano Systems ENAS, DE
C. Justeau, Lyon school of Chemistry, FR
B. Mielke, Technische Universität Chemnitz, DE
- Pulsed Jet Actuators and their integration in composite structures** 430
Mathias Lipowski, M. Schueller, T. Otto, T. Gessner, Fraunhofer Institute for Electric Nano Systems ENAS, DE
C. Stiehl, J. Nestler, L. Kroll, Technische Universität Chemnitz, DE
- A Novel Die Sawed Trench Structure for Warpage Reduction in Wafer Level Packaging Process** 434
Prof. Le Luo, Chunsheng Zhu, Gaowei Xu, Shanghai Institute of Microsystem and Information Technology, CN
- Concept of a quick-change-system for an industrial force sensor with an improved signal to noise ratio** 441
Dr. Joerg Maempel, Eric Markweg, Olaf Mollenhauer, TETRA Gesellschaft für Sensorik und Automation mbH, DE
Raiko Pevgonen, IMMS Institut für Mikroelektronik- und Mechatronik-Systeme gemeinnützige GmbH, DE
- 3D Integration of a membrane thermoelectric sensor array for space debris detection** 445
Matthias Mohaupt, Fraunhofer Institute for Applied Optics and Precision Engineering IOF, DE
Frank Hänschke, Leibniz-Institut für Photonische Technologien, DE
- MEMS Inertial Measurement of Ocean Waves** 449
Brendan O'Flynn, Donal Kennedy, Michael Walsh, Tyndall National Institute, IE
- Nanorez – A Miniaturised MEMS based resonator** 451
Brendan O'Flynn, Oskar Z. Olszewski, Loizos Loizou, Tyndall National Institute, IE
- How secure is my Smart System?** 453
Dr. Christopher Pickering, Neil Adams, Innovation Bridge Consulting Ltd, UK
Richard Chisnall, InnovaSec Ltd, UK
Simon Wiseman, Deep Secure Ltd, UK

Comparative analysis of multi-mass high precision vibratory MEMS gyroscopes 457

Dr. Irina V. Popova, Alexander Lestev, Maxim Fedorov, Oleg Rakityansky, Vladimir Ivanov, Andrey Semenov, Gyrooptics Ltd, RU
Karla Hiller, Susann Hahn, Technische Universität Chemnitz, DE
Thomas Gessner, Fraunhofer Institute for Electric Nano Systems ENAS, DE

Vertical Interconnect Access (VIA) in Technical Porcelain for MEMS 461

Manuel Stompe, Lutz Rissing, Leibniz Universität Hannover, DE

A Wearable Inertial Sensors-based Framework for Complete Gait Analysis 465

Salvatore Tedesco, Andrea Urru, Michael Walsh, Brendan O'Flynn, Tyndall National Institute, IE
Danilo Demarchi, Politecnico di Torino, IT

Improving the lifetime of a 3D-Radio Frequency Transceiver by finite element simulations 469

Marius van Dijk, Arian Grams, Katrin Kaletta, Olaf Wittler, Ivan Ndip, Fraunhofer Institute for Reliability and Microintegration IZM, DE

Christian Tschoban, Klaus-Dieter Lang, Technische Universität Berlin, DE

Integration and Test of Synthetic Jet Actuators 473

Perez Weigel, M. Schueller, M. Lipowski, T. Gessner, Fraunhofer Institute for Electric Nano Systems ENAS, DE

J. Nestler, T. Otto, Technische Universität Chemnitz, DE

Optimisation of Bio-medical Optical Waveguide 477

Yu Xin, A. Purniawan, G. Pandraud, L.S. Pakula, P.J. French, TU Delft, NL