MedTech

How Semiconductor Technology can contribute to Innovative Biomedical Systems

P. Simkens
Managing Director
DSP Valley, Leuven, Belgium

Abstract
Thanks to Moore's law, the semiconductor industry has built up a lot of experience in how to produce large volumes of products in a very miniaturised form and at a very low cost, and with a highly increased computing performance.
Modern biomedical systems are facing similar challenges: clinical tests on human fluids have to miniaturised in order to bring them closer to the patient, responding to the needs of personalised medecine. The analysis of the human genome, DNA sequencing and cell sorting (e.g. for early cancer detection) from their side require tremendously increased compute power. Just as in Moore's law, an exponential increase of the available compute power is required in order to make personalised medecine happen.
By combining the experience of mass production from the semiconductor industry with the techniques from the biotech, new solutions for the above described challenges can be unlocked.
This presentation will discuss the required cross-fertilisation between the two Key Enabling Technologies of micro/nano-electronics and biotech, and will illustrate the potential of this cross-KET approach with some emerging applications.

Biography
Dr. Peter Simkens holds a Master of Science degree in Mechanical Engineering (1984) and a PhD about "3D graphical simulation of sensor controlled robots" (1990), both obtained from KULeuven.
During more than 10 years, Peter Simkens was involved in development projects for the European Space Agency, including the development of training and simulation facilities for European astronauts, and the development of real-time IT-systems for space applications.
In 1998, Peter Simkens became managing director of DSP Valley, the cluster in Smart Electronic Systems, headquartered in Leuven (Belgium). He developed DSP Valley to an outstanding business and innovation cluster, where all participants are connected through strategic partnerships. He has been responsible for the internationalization of this cluster, by setting up an international network of clusters, enabling inter-cluster matchmaking opportunities.
He has transformed the DSP Valley eco-system from a cluster of micro/nano electronics technology providers to a full value chain cluster in smart electronic systems, including applications in smart health systems. Currently, he is building new strategic alliances to exploit the potential of cross-KET innovation, e.g. between micro/nano electronics and biotech (in partnership with FlandersBio), for new health applications in the so-called Nano4Health domain.

How to run a successful MES selection in MedTech

S. Proehl
Managing Director
CONVANIT GmbH & Co. KG, Dresden, Germany

Abstract

In times of Industry 4.0 a seamless tracking of all relevant information starting from enterprise planning down to logistics and the production itself becomes more and more important for MedTech companies too.
Today most MedTech companies are naturally using ERP systems to take care of their customer orders and the necessary logistics. But when it comes down to tracking and control on shop-floor level many of those companies are still using paper.
At the same time a paperless production offers substantial advantages in terms of seamless traceability, logistics and planning interaction as well as quality assurance. This is the point where Manufacturing Execution Systems (MES) come into the picture - systems that are standard in other industries e.g. semiconductor.

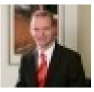
But how to successfully select a MES, especially for MedTech? There are many systems on the market offering a wide range of functionalities and usually a project budget is given - so what are the criteria to select "the right system" and how to choose the "right" partner? How long does it take to come to the "final" decision?
Based on long term experiences with various MES selection activities across different industries the presentation offers an approach for the MES selection, outlines and discusses selection and decision criteria and provides best practices for this process.

Biography

As an IT expert Steffen started his career at an IBM Global Services company. In 2000 he joined Infineon Technologies as member of a team to ramp up the first 300mm semiconductor Fab in the world. During this time Steffen became a Manager within the Infineon global MES competence center. As part of this work he was involved into all major MES activities world wide, starting with the MES selection up to the rollout and migration of the "ready-to-go" product to varoius Infineon Frontend and Backend sites.
In the year 2006 Steffen joined Qimonda as Senior Manager IT Production Automation responsible for core MES functionalities worldwide. For the fully automated production of a 300mm Qimonda Frontend site he was a key member of the automation core architecture and development project team.

Based on his long term experience in MES and automation - and with the background of various successful projects in Europe, the USA and Asia - Steffen started his own IT automation business in 2009. Together with 2 other colleagues he founded CONVANIT in 2010 - a company that specializes in the combination of Yield Management and IT automation. Despite the fact that the background of the company lies in the high-tech area of semiconductor CONVANIT today serves many customers outside semiconductors successfully transferring best practices into their industries too.

Implementing a Manufacturing Execution System successfully in a highly regulated environment



B. Marsoner
CEO
znt Zentren für Neue Technologien GmbH, Grünwald, Germany

Abstract
The Semiconductor industry has been using Manufacturing Execution Systems (MES) since many years for controlling and visualizing the production processes and improving quality while removing paper from the shop floor.
In the Medical Device industry this looks differently. Today still a lot of companies use paper for documenting their manufacturing process in order to produce compliant to regulatory imposed on them by FDA (Food and Drug Administration in US) and other Authorities.
Especially due to such regulatory, Medical Device Manufacturers are often struggling in introducing an MES into their environment. This presentation will focus on the key success criteria that Medical Device Manufacturers have to consider for successfully implementing an MES into their production environment.

Biography
Bernhard Marsoner is CEO of the znt-Richter group which consists of several companies developing and implementing innovative software solutions, with key focus on improving manufacturing operations in High Tech industries like Semiconductor, Electronics and Medical Devices.
Already in 1991 during his study of computer science at the Technical University of Munich. Bernhard Marsoner founded Richter Softwaretechnik GmbH together with Prof. Dr.-Ing. Axel Richter as member of the znt-Richter group. After 2009 he was made responsible for the znt entities in Singapore and Malaysia. In 2012 he also became Managing Director of znt Zentren für Neue Technolgien GmbH in Germany and was appointed CEO of the znt-Richter group with focus on Sales and Technology.

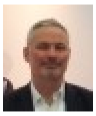
Coating, encapsulation, and packaging technologies for smart integrated systems

M. Baum
Researcher
Fraunhofer ENAS, System Packaging, Chemnitz, Germany

Abstract
Highly integrated and autonomous sensors and electronics fabricated using semiconductor technologies conquer our modern society in all possible fields. Smaller footprints, integrated communications and power supply should work together with high precision MEMS and electronics. Smart miniaturized systems enable novel applications but demand at the same time new materials, coatings, and packaging concepts to address functionality, biocompatibility, reliability, and live time as well as cost issues. Fraunhofer ENAS is facing these challenges in certain fields. Using nanoimprint technologies novel surface properties due to nano patterns could be achieved. Ionic liquids enable electro chemical deposition of special metals like Ti, Pd, Al and others or even for functional coatings or active sensor structures. Room temperature parylene deposition is used for homogenous biocompatible thin film coatings, for moisture barriers or intermediate layers. Different types of Parylene could be deposited including special pre-treatment processes at room temperature. Adpating well known screen and ink-jet printing processes together with 3D suitable aerosol-jet technologies nanoparticle based inks or pastes could be deposited on different substrates like flexible organics, polymers, PCB's, wafers, etc. Additionally the combination and process integration of these techniques with established micro system technologies will lead to better performances of micro and nano systems in future.

Biography
Mario Baum was born in 1975 in Burgstaedt near Chemnitz, East Germany. After taking a combined MBE (Master of Business and Engineering) degree at Chemnitz University of Technology he started working as an application engineer for a company called GEMAC mbH Chemnitz in the field of micromechanical sensor systems.
In 2002 he joined the team of Prof. Gessner at Fraunhofer ENAS (formerly Fraunhofer IZM) as a scientist with both research and marketing tasks. In 2015 he finished his Phd thesis on packaging topics. Currently his research work is focused on MEMS packaging and microsystems as well as medical applications.

Ultra low power microelectronics for wearable and implanted medical devices



S. Gray
Head of Marketing & Sales
CSEM, Neuchâtel, Switzerland

Abstract
Wearable sensors have been available for years, but have mostly been limited to heart-rate monitoring for athletes. The arrival of smart watches, as well as ubiquitous smart phones, has led to an explosion of wearable sensors and applications for healthcare and wellness. Nevertheless many products today remain bulky and need frequent re-charging, thus limiting more widespread application. This presentation will look at some recent advances in microelectronics for wearable sensors for medtech, from low power ASIC and SOC design, to choices about energy sources, antennas and processing and communication algorithms. It will be illustrated with some recent examples of miniaturised sensors for implantable and wearable sensors from both collaborative research projects as well as innovations for commercial products.

Biography
Simon Gray is responsible for marketing and business development in CSEM's Integrated and Wireless Systems Division. CSEM has been a pioneer in low power ASIC design and is today one of the leading design centers in Europe for ultra low power wireless sensing SOCs and systems. Prior to joining CSEM he held senior technical and marketing positions in the semiconductor industry for companies including Philips, Xemics and Semtech. He has a BSc in Physics from Nottingham University and an MBA from Open University.

Embedded passives on low profile Silicon substrate technology for Medical implants, Wearables and Connected Objects

F. Murray
CEO
IPDIA, CAEN, France

Abstract

Innovation is a "Must" in medical implants, wearables and other connected objects. IPDiA, as a center of excellence, is already deeply involved with the key players of Medical devices. These most recent innovative devices, based upon new implantable electrical stimulation technologies, are adopting these Silicon based technologies, to enhance the "performiniaturization" (a word invented by IPDiA).
On the performance side, design flexibility, low leakage current, extended life time and the suppression of burn in tests are making the differences. As a reminder this technology is also selected by the downhole players for its capability to withstand temperature of 250°C fduring 12 000hrs as well as by aerospace companies. On the miniaturization side, differences consist in the ability to be delivered with a very low thickness as well as innovative form factors for wearables and implants.
This presentation will concentrate on the technology and will be illustrated by several examples of solutions with innovative shapes, heterogeneous stacks with different form factors.

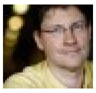
Biography

Franck Murray is presently the CEO of IPDIA.
IPDIA is developing, manufacturing and selling Integrated Passive Devices.
IPDIA has 120 employees. Since its start in 2009, IPDIA has a worldwide commercial presence and sells 90% outside Europe.

Franck got his Engineer Degree from Ecole Centrale de Paris in 1984 and an MBA at ESSEC (Paris) in 2003. He has also a PhD in Physics.

After his PhD, his first experience was with Philips in the development of LEDs.
This first experience led him to create a start up in Material Analysis and then move to a position of CTO of a start up in the field of optical disk.
He came back to Philips in 1996 (becoming NXP in 2006) to occupy various positions in Operations in Semiconductors Wafer Fab.
He moved to Corporate Innovation and R&D in 2000 with the assignment to develop new technologies and design tools and find new ways to miniaturize electronic devices. He also occupied several technology related corporate positions.
All this work has constituted the roots of today's IPDiA technologies.

From Chips in Organs to Organs-on-Chip



R. Dekker
Professor
Philips Research, Delft, Netherlands

Abstract

Micro-fabricated devices are finding their way to the frontend of medical equipment, where they are the interface between body, or in general living tissue, and machine. They enable better and cheaper diagnostic equipment, they add "eyes and ears" to minimally invasive instruments such as laparoscopic instruments and catheters, they allow for un-obtrusive monitoring of body functions, they add functionality to implants, and they enable the development of better and personalized medicines.

Despite their great promise it has been proven difficult to bring these devices out of the laboratory phase into production. One of the reasons is the lack of a suitable fabrication infrastructure. Much more than standard CMOS or MEMS devices, these medical devices rely on the processing of novel materials, especially polymers, in combination with advanced molding, micro-fluidics, and assembly technologies. At the same time these devices have to be fabricated under strict quality control conditions in a certified production environment.

In the recently granted ECSEL project "InForMed" a supply chain for the pilot fabrication of these medical devices is organized, which brings together key European technology partners in an integrated infrastructure linking research to pilot and high volume production. The pilot line is hosted by Philips Innovation Services, and open to third party users.

Biography

Ronald Dekker received his MSc in Electrical Engineering from the Technical University of Eindhoven and his PhD from the Technical University of Delft. He joined Philips Research in 1988 where he worked on the development of RF technologies for mobile communication. Since 2000 his focus shifted to the integration of complex electronic sensor functionality on the tip of the smallest minimal invasive instruments such as catheters and guide-wires. In 2007 he was appointed part time professor at the Technical University of Delft with a focus on Organ-on-Chip devices. He published in leading Journals and conferences and holds in excess of 50 patents.

Cost efficient miniaturised silicon micropumps for medical applications

M. Richter
Head of Department
Fraunhofer EMFT, Micromechanics, Actuators and Fluidics, Munich, Germany

Abstract

Drug delivery components like micropumps to be in contact with medicals have to be disposable and for that very cost efficient. Beside functional challenges like back pressure, particle tolerance, free flow protection, flow control and dosing accuracy, these cost requirements are hurdles for successful industrialization of micropumps.

The smallest state of the arte micropumps are made of Silicon (e.g. chip sizes: Fraunhofer micropump 7x7 mm2, Debiotech micropump: 6x10 mm2). That chip size makes it very difficult to meet manufacturing costs below 1 $/chip, even at mass production.

It is evident that manufacturing cost scale down with the chip size of the silicon micropump.

With that, to address high volume medical applications like therapy of diabetes or other medical patch pump applications it is essential to shrink the micropump chip furthermore.

On the other side, from physical reasons it is just difficult to meet micropump performance parameters like stroke volume, flow rate, compression ratio or back pressure ability, if the lateral dimensions of the actuation diaphragm will be reduced.

Next, not only the silicon front end technology, also the back end manufacturing steps like piezo mounting has to be cost efficient. Finally, also the fluidic test cost of the micropump chip.

In this presentation an overall strategy will be presented for a Technology platform for Silicon micropumps with small chip sizes down to 3x3 mm2. Results of this strategy regarding piezo mounting on wafer level, fluidic micropump test on wafer level are explained.

Finally, first performance results of a 5x5mm2 micropump chip will be presented

Biography

Martin Richter´s mission is to enable microdosing systems for industrial applications. He studied Technical Physics at the Technical University Munich. His PhD about Simulation and experimental characterisation of microfluidic systems was finished 1998. Since 2000 he is head of department Micromechanics, Actuators and Fluidics of Fraunhofer EMFT in Munich.

Novel Health Solutions for patients and consumers

H. Joos
Managing Director
FlandersBio vzw, Gent, Belgium

Abstract
The Health Management space where pharmaceutical and biotech companies traditionally were the sole actors is being disrupted dramatically due to the entrance of new players traditionally active in the food or consumergood space. The presentation is going to explain what are the key causes for this perfect storm, but will also elaborate on the challenges of collaboration in this new space.

The presentaion will also explain the activities that are specifically undertaken in the region of Flanders (Belgium) in order to manage this storm.

Biography
Dr. Henk Joos had a career in different farmer oriented biotech projects in Plant Genetic Systems, AgrEvo, Aventis and Bayer CropScience before he became involved in the development of novel feedstock species for the production of energy.

Dr. Joos became managing director of FlandersBio in December 2013.

WIRAplant WIReless Active imPLANTs

M.-J. Büker
Researcher
Fraunhofer ENAS, ASE, Paderborn, Germany

Abstract
Implants with actuators and telemetry functionalities require a lot of energy. Therefore wireless charging of the implants is useful: Inductive wireless charging of the Implants through the skin with ranges from 5cm (5W) to 15cm (0,5W). By using smart antenna structures we can deliver an optimized lateral freedom for displacement. Also a impedance matching method is introduced to improve efficiency. The presentation will be rounded off to telemetry through the transition and actuators.

Biography
Maik-Julian Bueker was born in Germany in 1982. He received the diploma degree in electrical engineering from the University of Paderborn, Germany in 2008. His current research interests focuses on wireless energy transmission and nearfield coupling.

REAL-TIME DEFORMABILITY CYTOMETRY: HIGH-THROUGHPUT CELL MECHANICAL PHENOTYPING

O. Otto
Postdoctoral Researcher
ZellMechanik Dresden GmbH i.G., Dresden, Germany

Abstract
The mechanical properties of cells have long been considered as a label-free, inherent marker of biological function in health and disease. Wide-spread utilization has so far been impeded by the lack of a convenient measurement technique with sufficient throughput, sensitive to cytoskeletal changes. To address this unmet need, we introduce real-time deformability cytometry (RT-DC) for continuous mechanical single-cell classification of heterogeneous cell populations at rates of several hundred cells per second. Cells are driven through the constriction zone of a microfluidic chip leading to cell deformations due to hydrodynamic stresses only. Our custom-built image processing software performs image acquisition, image analysis and data storage on the fly. The ensuing deformations can be quantified and an analytical model enables the derivation of cell material properties.

Performing RT-DC on whole blood we highlight its potential to identify subsets in heterogeneous cell populations without any labelling or extensive sample preparation. We also demonstrate the capability of RT-DC to detect lineage- and source-specific mechanical phenotypes in primary human hematopoietic stem cells and mature blood cells. Finally, we find that different stages of the cell cycle possess a unique mechanical fingerprint allowing the distinction between cells in G2 and M phase, which is not possible using standard flow cytometry approaches. In summary, RT-DC enables marker-free, quantitative phenotyping of heterogeneous cell populations with a throughput comparable to standard flow cytometry for diverse applications in biology, biotechnology and medicine.

Biography
2015 - Spin-off ZellMechanik Dresden GmbH i.G.

since 2013 - Postdoc Biotechnology Center, TU Dresden, Research Group of Prof. Jochen Guck

2008 - 2012 - PhD in Biophysics, Cavendish Laboratory, University of Cambridge (UK)

2002 - 2008 - Diploma in Physics, University of Leipzig (Germany)

2006 - 2008 - Student Trainee at Bosch (China)

1999 - 2002 - Diploma in Information Systems and Business Administration, University of Cooperative Education Mannheim (Germany)

Adaptive PolCarr® carriers for novel applications in live science

H. Schmidt
Group Leader
Faculty of Electrical Engineering and Information Technology, Department of Materials for Nanoelectronics, Chemnitz, Germany

Abstract

The selective attachment of molecular or cellular biological elements on flat substrates plays a critical role towards advancements in the field of adherent cell growth in biotechnology. As majority of the available market for live science products is based on the functionalization of substrates, new approaches offering carriers with superior performance i.e. with easy-to-control immobilization and detection of the target bio-elements are of considerable interest. Following this trend, herein we propose a promising concept for new carrier design - PolCarrWell. PolCarrWell stands for the customized PolCarr® carrier (a doped Si-wafer with an ultra-thin insulating film and a characteristic pattern of surface near electrostatic forces, SNEF [1,2]), which is design-compatible with standard bottomless microwell plates. Though, a myriad of microplate types have been devised and successfully commercialized over the past decades, the controlled entrapment of analytes remains a challenging matter. To alleviate this challenge, manifold coatings, e.g. functionalized polyelectrolytes [3], are being applied. Unfortunately, the immobilization via functional coatings on such surface-functionalized microwell plates is very sensitive to the environmental conditions. Variable temperature, pH, pressure and humidity may strongly injury the overall binding effect. In stark contrast, the newly developed bulk-functionalized PolCarrWell (PolCarr® carrier coupled with a standard bottomless well microtiter plate) offers a highly controlled, environmentally inert immobilization of the adherent and electrically polarizable bio-element. The entrapment is purely driven by the SNEF, which can comfortably be modulated.

[1] C. Baumgart, M. Helm, H. Schmidt, Phys. Rev. B. 80 (2009) 085305
[2] H. Schmidt, S. Habicht, S. Feste, Anne-Dorothea Müller, O. G. Schmidt, Appl. Surf. Sci. 281 (2013) 24-29

[3] Advances in Polymer Science 255 & 256 (Ed.: Martin Müller), Springer, 2014

Biography

H. Schmidt from Technical University Chemnitz has completed her Ph.D in semiconductor physics at the University Leipzig in 1999. Since 2003 she heads the "Nano-Spintronics" group and develops artificial synapses for cognitive computing and smart carriers for live science applications. H. Schmidt has published more than 160 papers in peer-reviewed journals and served as an advisory program committee member for the international workshops subtherm-2011, WSE-2014, and WSE-2015. She received the Nano-Future prize from the Bundesministerium für Bildung und Forschung (2002) and a Heisenberg Fellowship from the German Science foundation (2011).