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TechARENA: Sensors for IoT

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soitec

Biography
Ionut Radu is Senior Manager of Soitec's Corporate R&D organization and is responsible for research and development efforts in the field of advanced substrate technologies. Prior to being appointed to his current position, he held technical and project management positions with responsibility to develop new substrate technologies for advanced electronic devices. Ionut is currently involved with industrial and academic research collaborations to support strategic developments of advanced substrate materials for semiconductor industry.
Dr. Radu obtained his B.S. in physics from University of Bucharest in 1999 and Ph.D (Dr. rer. nat.) in physics from Martin-Luther University Halle-Wittenberg in 2003. He has co-authored more than 60 papers in peer-reviewed journals, conference proceedings and reference handbooks and holds more than 30 patents in the field of semiconductor technologies. Dr. Radu is senior member of IEEE society and involved in Technical Program Committees of international conferences (ESSDERC, VLSI-TSA) and industrial forums (Semicon Europa).

Pressure Sensors: Challenges in Design and Production

M. Peschke
Vice President Production
First Sensor AG, Production, Berlin, Germany

Abstract
Pressure sensor manufacturers cover a broad range of processes and technologies to produce high-performance sensors and sensor systems for pressure ranges between 0.01 and 2,000 bar. Trends such as the on-going miniaturization in sensor technology, higher demands on reliability and long-term stability or growing intelligence lead to challenges within the value chain of sensor production. Manufacturers have to develop innovative solutions for growing market demands. In addition, they have to consider investments, flexibility, quality, and cost influence in production.

In Front End production, high investments in “standard” semiconductor processes and special MEMS processes are combined with essential effects on sensor quality. Innovative packaging solutions can significantly influence the robustness of sensors. A rising influence on costs during the manufacturing process can be noted for calibration which is driven by intelligence and functionality requirements. Moreover, the demand for new and competitive technologies for high pressure ranges is growing.

The lecture focuses on pressure sensor manufacturing steps and works out challenges as well as upcoming trends in sensor technology. Examples for corresponding solutions developed by First Sensor will be introduced, e.g. the use of thicker backplates during packaging processes to ensure mechanical decoupling. Further topics are First Sensor’s STARe technology for higher long-term stability and T-Bridge as a flexible technology for high pressure measurement. Furthermore, the advantages of COB and TSV micro soldering technologies will be discussed.

Biografie
Dr. Matthias Peschke completed his degree in Physics at TU Darmstadt and wrote his doctorate on the topic of “The effect and technology of gas-sensitive field-effect transistors.” He is a recognized expert for, e.g. the qualification of a variety of technologies, the development and implementation of series production processes, and transnational technology transfers and synchronizations. Dr. Matthias Peschke is Vice President Production and has been part of the management team of First Sensor AG since 2015.

Passive wireless SAW sensors using advanced piezoelectric material and structures

S. Ballandras
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Abstract
Passive acousto-electric devices are extensively used for now quite a long term for various radio-frequency applications. Among all of these, the possibility to develop sensors and associated systems using surface acoustic wave (SAW) or bulk acoustic wave (BAW) devices has been widely investigated and has yielded numerous academic as well as industrial developments. Particularly, the capability of these devices to be remotely controlled without on-board power supply has received a growing interest during the passed 15 years. Different strategies can be implemented for probing these sensors, based on time-domain analysis or using spectrum techniques depending on the sensor nature. Whatever the considered approach is, an effort must be paid to adapt the device architecture to a reliable translation of the perturbing effect. The accuracy of the system is therefore controlled by the stability of the measurement approach. According to targeted resolution/accuracy, these sensors can be used for monitoring temperature, pressure, stress or any combination of these parameters in industrial or day-life process.
These devices have made an extensive use of standard single-crystal substrates such as quartz, lithium tantalate and niobate. However, new challenges have pushed the development of alternative crystals (Langasite and related materials, GaPO4, BST, etc.) particularly suited to high temperature applications and also composite wafers based on piezoelectric films on Silicon Sapphire and other non piezoelectric substrates.
In this presentation, we introduce basic principles of radio-frequency acoustic devices and the various structures usually implemented for sensors. Several examples allows for illustrating the implementation of these devices and a focus is then proposed on material development for wireless SAW/BAW sensors. We provide an outlook of state-of-the-art wireless applications, with a discussion on further developments of such devices and their relation with IoT.

Biografie
Sylvain Ballandras was born in Strasbourg in 1965. He joined the CNRS in 1991, after his PhD in Engineering Sciences from the Université de Franche-Comté. He joined Thomson Microsonics in 1997 for a one year industrial training project. From 1999 to 2005, he was responsible of the Acoustics & Microsonics research group at CNRS/LPMO. He also created at that time a consulting office to answer other demands from industry. In October 2003, he was promoted Research Director at CNRS, in the newly created FEMTO-ST Institute in Besançon. From 2005 to 2008, he was co-director of the joined laboratory between TEMEX company and FEMTO-ST devoted to SAW filters and sensors. In 2008, Sylvain Ballandras group joined the Time-Frequency Department of FEMTO, creating the CoSyMA research platform for industry/academic partnership in acoustics. He has been involved in the creation of SENSeOR, a company dedicated to wireless SAW sensors as CSO (part time) of the company from the end of 2008 till beginning of 2012. In March 2013, he left the CNRS to create his own company, frec|n|sys, devoted to the design, fabrication and marketing of SAW resonators and filters, acoustic-based RF-MEMS devices and SAW sensors for harsh environment applications. He was laureate of the French Research Ministry contest for innovative company creation in 2013. frec|n|sys has received several honorary recognitions to encourage its growth from 2013 till today. Sylvain Ballandras is a member of the IEEE UFFC Society.

With RFID Sensors into the Cloud

F. Deicke
Head of Business Unit Wireless Microsystem
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Abstract
RFID technology is mainly applied in the area of logistics, traditionally used to identify objects, goods or commodities. Modern industrial applications also often require the wireless measurement of physical parameters such as temperature, humidity, light, pressure or acceleration with the help of sensor technology. This is especially the case when the use of cable connections are not possible due to inaccessible locations and moving or rotating parts. In such situations, passive RFID sensor transponders provide a viable solution by combining extremely energy-efficient sensor technology with standards-based RFID protocols. The energy needed to measure sensor values is completely delivered via commercially available RFID readers.
Because of their high energy needs, active wireless systems usually rely on replaceable or rechargeable batteries for additional energy storage. In this context, there is always the question of maintenance costs incurred with either replacing or recharging energy stores. Taking energy directly from the field of the reader, passive RFID sensor transponders are, in contrast, completely maintenance-free and, with a virtually unlimited service lifetime, can be incorporated into inaccessible places.
The presentation is about how to deploy RFID-based sensor transponders into modern real world application scenarios comprising issues such as reader integration, software based system integration using OPC-UA and Auto-ID companion specification as well as cloud based client solutions. It is also discussed how to use sensors and actuators in combination to not only receive measurement data but also interact within a system.

Biografie
Frank Deicke is head of business unit Wireless Microsystems at Fraunhofer IPMS. He received his diploma and Ph.D. from TU Dresden in electrical engineering, short range, and RFID communication in 2004 and 2009. After that he joined Fraunhofer IPMS as a scientist. Later he setup a new R&D group developing short and mid-range Li-Fi communication technologies. Frank Deicke is co-founder of Li-Fi consortium. Since 2015 he has been head of business unit Wireless Microsystems and responsible for Li-Fi and sensor-based RFID technology developments as well as system integration.

Air and water quality monitoring with low cost sensor networks

M. Zevenbergen
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Abstract
Both air and water quality has a strong influence on human health and wellbeing. Monitoring the air/water quality and making the data available to end-users is the first step towards awareness for a healthier society and environment. To achieve this goal, measuring sufficient spatial and temporal data is critical and hence dense sensor networks are needed, both indoor and outdoor. The sensors in these networks need to be relatively low cost, preferable small and low power. The talk will outline the state of the art in gas and water sensors for air/water quality monitoring networks and considers emerging and potential future developments.

Outdoor gas sensor network will mainly monitor pollution and measure pollutants including nitrogen monoxide (NO), nitrogen dioxide (NO2), sulphur dioxide (SO2), carbon monoxide (CO), ozone (O3) and volatile organic compounds (VOCs). In case of indoor applications, air quality is more related to comfort (temperature, humidity, carbon dioxide (CO2)) or to safety (VOC's, CO). Holst Centre/imec the Netherlands is developing wireless sensors nodes that are able to quantify multiple parameters (both with of-the-shelf and in-house developed sensors) validated in real life applications.

For water quality monitoring, I will introduce a single-chip electrochemical sensor for simultaneous detection of multiple ions in fluids. The first generation is able to quantify pH and conductivity, two crucial parameters for water quality assessment. This sensor solution is a generic platform that can be extended to other ions tailored towards specific applications beyond water quality, such as monitoring of nutrient concentrations for agricultural applications and disposable point-of-care solutions for bodily fluids.

Next to sensor technology, also smarter network design, smarter data use and new tools will be shown. The need for good calibration and reference measurements, to ensure good data quality from these sensor networks, will be discussed.

Biografie
Dr. Ir. Marcel Zevenbergen received his PhD in physics at Delft University of Technology in 2009. During his PhD, he developed an electrochemical sensor capable of detecting single molecules in solution. In 2010, he joined Holst Centre/imec the Netherlands where he develops novel electrochemical sensors for water quality, nutrient monitoring and healthcare.

Sensors for Mobiles, Wearables and Home and Building Automation.

E.J. Lous
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Abstract
Sensing is often the trigger to a number of events. The sensed property is communicated into a system or network, where analysis is made that eventually results in one or more responding actions. To create meaningful responses, sensible inputs and analysis need to be derived. This is exactly the playfield of CMOS technologies, where its computational power can support seemingly complex situations. The Internet of Things, IoT, is one of such environments where a lot of sensing information is expected to be shared to the benefit of human wellbeing. These application areas are numerous and hence a few situations will be elucidated for smart buildings and personal info systems, where internet can play an interesting role.
For many applications the development of IoT often requires sensors at relative cheap prices, while not giving in on performance and quality. Not the least also small form factors and low power, enabling battery and energy scavenging use are dreamed off. Also here CMOS technologies are providing the solutions and driving the capabilities. Therefore, sensors are becoming a 4th option technology in CMOS fabs, besides the current 3: RF, High Voltage and embedded memories. Together with advanced packaging and test methods, miniaturization and mass production are being enabled. Design libraries can be developed in classical ways to integrate sensors with sensor interfaces in new ASIC designs. This enables highly integrated, high performance sensor solutions, well capable to realize many IoT sensor ideas.
The above will be shown with a few examples in the areas of humidity, temperature, pressure and gas sensing, biosensors, imaging and several other optical sensor solutions for Mobiles, Wearables and Home and Building Automation.

Biografie
Erik Jan Lous is Engineering Fellow for ams, located in Eindhoven, The Netherlands, He studied Physics and Chemistry at the State University Leiden, The Netherlands. In 1988 obtained his PhD in Biophysics on Photosynthesis, followed by 2 post-doc years at the University of California at San Diego. He has about 26 years experience in the semiconductor process technology, starting in Philips Research, Philips Semiconductors, NXP and currently at ams. From this, 14 years were in sensors areas of: 180nm process, Medical Imaging, PET, SPAD, biosensors, BAW, AMR, HV, mems switch, mems oscillator, mems microphone, relative humidity, temperature and pressure sensors. He has served as development manager and has been part of Technology Management & New Business Creation Teams. Currently he is now 2 years in ams and working in the BL Environmental Sensors.