MEMS Session

M. Vogel
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Biography

Martina Vogel studied physics at the University of Technology Chemnitz, Germany. She obtained her PhD from the same university in 1994. From 1996 until 2001 she worked as project manager in the GPP Chemnitz mbH. From 2001 until 2006 Martina Vogel was responsible for quality assurance of memory products at ZMD. In 2006 she joined the Center for Microtechnologies of Technische University Chemnitz. Since 2009 she is with Fraunhofer ENAS and works as advisor to the institute management and manager marketing/PR. Since 2015 she works additionally as strategy coordinator of the institute.

Status, Challenges and Opportunities for MEMS and Sensors

E. Mounier
Principal Analyst, Technology & Market, MEMS & Photonics
Yole Développement, Lyon, France

Abstract

The dynamic is very positive for the MEMS markets. And although the market reached maturity, it is still expected to grow at a significant rate for the coming years: 18% in value and 27% in units, over 2018-23 for the global MEMS devices. With new mega trends such as robotic cars, autonomous vehicles, AI, AR/VR, 5G, Industry 4.0, … the demand for sensors will grow as for MEMS. Moreover, it is still a domain with a lot of innovation as new devices are in R&D today (speakers, gas sensors, hyperspectral imagers …). And this wave of innovation is also confirmed by the good 2017 business year realized by most of the MEMS players.

The presentation will highlight the present and future of the MEMS markets, and how new applications such as smart vehicles, AI, mobility … will contribute to the business growth.

Biography

With almost 20 years of experience in MEMS, Sensors and Photonics applications, markets, and technology analyses, Dr. Eric Mounier provides deep industry insight into current and future trends. As a Principal Analyst, Technology & Market, MEMS & Photonics, in the Photonics, Sensing & Display division, he is a daily contributor to the development of MEMS and Photonics activities at Yole Développement (Yole), with a large collection of market and technology reports as well as multiple custom consulting projects: business strategy, identification of investments or acquisition targets, due diligences (buy/sell side), market and technology analysis, cost modelling, technology scouting, etc. Previously, Dr. Mounier held R&D and Marketing positions at CEA Leti (France).
He has spoken in numerous international conferences and has authored or co-authored more than 100

papers.
Eric has a Semiconductor Engineering Degree and a Ph.-D in Optoelectronics from the National Polytechnic Institute of Grenoble (France).

Design Enablement for the Next Generation of MEMS Products

C. Dufour
MEMS PDK Program Manager
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Abstract
The semiconductor industry has established integrated design environments based on PDKs (Process Design Kits), standard cell libraries, memory architectures, and IP. This design infrastructure is a key success factor, providing easy access to CMOS technology for IC designers, and increasing the chance of first-pass successful silicon. Can these features and benefits be brought to MEMS product designers? MEMS-based component suppliers want to reduce their time to market and rapidly ramp their designs into high-volume production, by reducing design spins and fabrication cycles. At the same time, a new MEMS design often requires process development not typical in CMOS design. While the prior MEMS rule “one process, one product” has become weaker over the last few years, MEMS design tools must still be very much “process aware” and adaptable to process modifications. Ideally, a design environment and design methodology for MEMS should enable efficient re-use of technology and design knowledge while supporting manufacturing process changes and design optimization.
We will present a new methodology for MEMS design that uses MEMS Process Design Kits. These PDKs can be the “golden” container for MEMS technology and design information, and increase the chance for first-pass successful silicon. Based upon proven technologies from X-FAB and CEA Leti, we will share examples of MEMS component libraries that contain multi-physics compact models (rigid or flexible shapes for masses and membranes, electrostatic combs, piezo resistive gauges, suspension beams) and demonstrate how these models and libraries enable the reuse of characterized structures across multiple designs. We will then demonstrate how a parameterized and interactive component library, combined with a MEMS PDK interface, can facilitate the adaptation to foundry specific processes, provide designers with the ability to quickly explore a broad design space, and optimize designs for performance and manufacturing.

Biography
Christine Dufour is MEMS PDK Program Manager at Coventor since August 2016. Christine has more than 20 years of experience in the semiconductor industry, leading process design kit (PDK) development for BiCMOS and CMOS processes in several major semiconductor companies. Christine has also worked as a Product Manager in the RF design environment area. She has extensive experience in PDK development and all aspects of design flow and design tools. She is now collaborating with leading MEMS foundries and MEMS research institutes to develop and promote innovative design platforms for MEMS sensor design & integration with support for PDKs.

MEMS - General and Plasma Dicing Process

B. Holz
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Abstract
MEMS devices such as Pressure sensors, Accelerators, RF-MEMS, Microphones, Bio-MEMS, Printer heads, etc. are very sensitive and hence require gentle die singulation technique. Such technique needs to be very clean, not generating any particles, preventing mechanical stress, vibrations, or ESD damages, and in particular, it should work without any cooling fluids. As well known from conventional diamond blade dicing all these influences may damage fragile mechanical MEMS structures like membranes, micro holes or sensitive chemical coatings.
In contrast to blade dicing and other ablation laser techniques, the “ML laser technology” is using a low energy IR laser beam that is focussing into the Silicon bulk. Hereby a so called modification layer with defined punctual stress profile is generated that works effectively as a hyphenation point. The die separation itself takes place by subsequent dicing tape expansion. Since only a very limited interior region of the wafer is processed by laser beam irradiation, mechanical or thermal damages and die edge chipping can be avoided.
Latest ML dicing machine generation and its accessory tools combines fully automatic operation, superior die separation quality with high productivity. The latter is achieved by a newly developed multi-beam laser engine that is built on a high speed machine platform allowing dicing feed speeds up to 1000mm per second.

The presentation provides an overview about typical MEMS applications for the ML singulation process, its requirements and limitations, as well as about laser dicing process variants like double side laser irradiation of MEMS wafer stacks and laser irradiation through tape (LTT).

Biography
Bernhard Holz has more than 30 years of experience in production of semiconductor devices, especially in mechanical processing technologies like wafer grinding, polishing and dicing. He made a diploma in mechanical engineering at the Technical University Berlin, afterwards he received a PhD in the field of Silicon wafer manufacturing and sub-surface damage analysis at the PTZ Berlin. From 1994 he worked as R&D Manager for a supplier of wafer slicing and grinding machines. He jointed Accretech Europe in June 1998. As Process Technology Manager he is responsible for customer application support for Polish Grinders as well as Wafer dicing machines. As head of the European demo & application center in Munich he further drives blade and laser dicing process developments, evaluations and services for various European Semiconductor as well as MEMS companies.

Organic Nanofibers as Next Generation Chemical Sensors for Real-time Process Monitoring

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VAPORSENS
NANOFIBER CHEMICAL SENSORS

Abstract
Early detection of gas phase chemicals can ensure product integrity, and human safety. New types of chemical sensors are being developed that are sensitive, selective and rapid for direct vapor detection of hazardous chemicals.

These next generation chemical sensors are based on novel organic nanofiber materials that demonstrate photoconductive and chemiresistive responses to surface adsorption of chemicals. The nanofibers are prepared via self-assembly of building-block, core molecules that are uniquely functionalized with a variety of tail and head groups that enable sensitive and selective binding and electron transfer interaction with different chemical analytes. When placed on a substrate, nanofibers form a porous super-net structure with large surface area and high porosity that can capture target molecules from the air through molecular diffusion and surface adsorption. Upon capture the electron density associated with the nanofiber structures can either increase or decrease resulting in an observable change in electrical conductivity that signals a detection event. For enhanced selectivity nanofibers of different chemical functionality can be deployed in sensor arrays. In addition to selectivity, the nanofiber sensors are also highly sensitive. Certain chemical species have been detected at the low parts per trillion (ppt) level. Nanofiber sensors are particularly sensitive to amines, aldehydes, volatile organic compounds, and toxic industrial chemicals.

Vaporsens, Inc. has developed autonomous nanofiber chemical microchip sensors and sensor arrays that can be deployed in small portable detectors and/or fixed distributed networks. Nanofiber chemical sensors can deliver lower limits of detection and faster response times than other commercially available chemical sensors.

Biography
Douglas Later is a business leader and Ph.D. analytical chemist with 30 years of experience in both small and large businesses, including several high-tech startup companies. Doug's corporate leadership roles and experience are in the areas of business development, research and development, design and engineering, manufacturing, quality assurance/quality control, regulatory compliance, customer service, marketing, and sales in analytical instrumentation and chemical manufacturing settings, as well as a service laboratory environment. His experience also includes international and national expertise in collaborative research and development, engineering, technology licensing, distributor agreements, marketing, and joint-venture business development.

Dr. Later has proven communication skills with more than 250 technical and business publications and several hundred technical and business presentations in the various fields of chemistry and biology including book chapters, journal publications, published proceedings, government reports, regulatory methods, as well as conference, seminar and symposia presentations.

He has also been a principal investigator and project manager of government and commercial grants and contracts from federal agencies such as the U.S. Department of Defense, National Science Foundation, U.S. Environmental Protection Agency, U.S. Department of Agriculture, U.S. Department of Energy, U.S. National Institute of Health, and U.S. National Cancer Institute.

Robust Magnetic Sensors for Condition Monitoring in availability-oriented Product Service Systems

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Abstract

Globalization, Industry 4.0 and increasing price pressure are only a few impact factors influencing the competition in the capital goods industry. There is a trend for machine builders to differentiate by creating individual bundles, consisting of technical products and lifecycle-oriented services, called Product-Service Systems (PSS). Smart sensors are a key enabling technology for availability-oriented PSS. Within the German state-funded R&D project “InnoServPro”, Sensitec GmbH is working with a number of partners to develop innovative service products for individualized, availability-oriented business models. One use case studied concerns the condition monitoring of the primary conveyor belt of a potato harvester. A specially-developed magnetic MEMS sensor, based on the magnetoresistive (MR) effect, is capable of identifying damage to steel rods, which are a major component of the conveyor. This information is used to estimate the remaining useful life of the conveyor, in order to plan maintenance optimally and so increase machine available. These new technologies are already progressing to industrial applications. In tobacco cutting machines the cutters are typically re-sharpened at fixed periods. A new MR-based magnetic sensor is capable of monitoring the sharpness of the cutters to allow local, in-process re-sharpening of the cutters without stopping the machine. This solution provides significant benefits, in terms of increased machine availability due to reduced down-time for re-sharpening the cutters. There are also unexpected additional benefits for the machine builder. The magnetic measuring principle can recognize original OEM-cutters so preventing machine down-time due to use of lower quality, non-original components. New magnetic sensors, based on the MR effect, combined with new software functions for smart signal processing are proving an essential enabling technology for new product-service-systems that benefit both end-users and machine builders.

Biography

Dr. Rolf Slatter gained his PhD in Mechanical Engineering at the Imperial College of Science, Technology and Medicine, University of London. From 1988 to 2006 he was employed at Harmonic Drive AG in Limburg as Production Manager, Sales Manager and ultimately as Director for Sales & Marketing. He also co-founded and was Managing Director at Micromotion GmbH in Mainz from 2001 to 2006. In 2007 he started at Sensitec GmbH in Lahnau as CTO and has been CEO and Managing Partner since 2010. He is also owner of ITK Dr. Kassen GmbH in Lahnau. Furthermore, Dr. Slatter is Chairman of the Board of the Innovation Platform for Magnetic Microsystems INNOMAG e.V., Member of the Board of AMA Association for Sensors and Management and is a member of the Council for Technology of Rhineland-Palatinate.