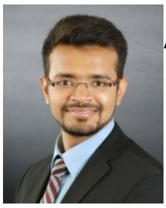
MEMS along the Value Chain

Factors Affecting the Market Landscape for Sensors



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Abstract
Sensors are found in a wide range of applications and industry sectors and the market is as a result in good health overall. While consumer sensors are adopted rapidly and wax and wane rather more quickly as markets, new sensing applications quickly emerge to keep MEMS sensor suppliers busy. While smartphones still represent a huge market, commoditization has left it saturated in value terms, but growth has recently moved to other accessories like smart watches or wireless earbuds from leading suppliers like Apple. Such devices are becoming very smart, involving multiple accelerometers and silicon microphones per set, and potential further functionality on the way in the form of heart rate, even oxygen saturation, and blood pressure. Talking of pressure, this sensor was recently adopted in e-cigarettes for puff detection.

Other mainstays like automotive and industry, on the other hand, are subject to longer-term trends like electrification and robotization of the car, as well as Industry 4.0, big data and condition monitoring. Meanwhile, autonomous cars or taxis are not the only markets to watch: automation of many functions is taking place, e.g. in smart cities, smart building such as warehouses and logistics operations, in logistics and package tracking, in drones for surveying and mapping. Agriculture is also benefiting from sensors, drones are used for crop spraying, for example, and other sensors are used to monitor other key metrics like acidity, etc. Robotics and automation implies many sensing devices including position, motion and pressure sensors.

This presentation looks at the impact of these major market changes on MEMS and other silicon sensors.

Biography
Mr. Noman Akhtar, a research analyst at IHS Markit, focuses on the Industrial market dynamics on semiconductors and sensor.
Noman shares his expertise with the IHS Markit semiconductor team and leverages his deep understanding of the impact on industrial sensors and semiconductors along with analyzing its supply chain.

He has deep technical knowledge in electronic component especially power electronics component in industrial semiconductor applications such as in factory automation, lighting, security, energy, medical, power and energy, military and aerospace segments systems. He manages the data quality of IHS Markit semiconductor and sensors market share databases and its timely delivery to clients. His responsibilities also include the synthesis of worldwide economic trends to help generate accurate market forecasts.

Prior to this, Noman Akhtar led IHS Markit smart city intelligence service and had developed a broad understanding of smart cities project, related technologies, and regional business strategies. He also has a strong understanding of smart home appliances, robots and their semiconductor BOM within the consumer electronics segment.

Noman joined IHS Markit in May 2014. Noman holds a Master of Science in Power Engineering specializing in power electronics in smart industry, smart home and smart grid electronics from the Technical University of Munich, Germany and a Bachelor of Science in Electronic Engineering from Sir Syed University of Engineering and Technology in Karachi, Pakistan. He is based in Munich, Germany.

A Roadmap for the future inline control and yield management in MEMS production

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CONVANIT

Abstract
The International Roadmap for Devices and Systems (IRDS) initiative focuses on maintaining a 15 year roadmap leveraging work of roadmap teams closely aligned with the advancement of the devices and systems industries. Led by an international roadmap committee (IRC), International Focus Teams (IFTs) collaborate in the development of a roadmap to help ensure alignment and consensus across a range of stakeholders. The IRDS roadmap is separated into chapters. Within the chapter of Yield Enhancement the specific requirements on inline control and yield management of MEMS production is described.

New inspection and characterization challenges are generated in the production of MEMS specific technologies, devices and materials. Those cannot be covered with the existing mainstream solutions and need new innovation and solutions.
These new techniques are mainly not yet available on production reliable level. Development of trend-setting methods and furthermore adaption to productive level are necessary.
The roadmap describes all MEMS related requirements like wafer thickness handling, task specific inspection challenges, CD measurement, aspect ratio and material related challenges.

Biography
- **2010 - now Senior Consultant Yield Management,** CONVANIT
- **2005 - 2009, Technical Manager for Yield Enhancement,** Qimonda Dresden
- **2002 - 2005, Project Manager for Defect Density Methodology,** Infineon Technologies Munich
- **1997 - 2001, Manager of Defect Density Group,** Infineon Technologies USA
- **1993 - 1997, Process Engineer Integration,** SMST GmbH Stuttgart
- **1989 - 1993, Process Engineer for Process Control,** IBM GmbH Stuttgart

Master in Physics, 1989, University of Karlsruhe

Pushing the Limits: Recent Advancements in the Optical Characterization of MEMS Devices

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Abstract

Instruments for analysis and 3D visualization of dynamic response and static shape are key for developing MEMS. They are indispensable for validating FE calculations, determining cross-talk effects and measuring surface topography and deformation.

State of the art metrology solutions as the new Polytec MSA-600 Micro System Analyzer combine several measurement techniques into a convenient “All-in-One” solution for 3D motion analysis and surface metrology. This instrument delivers increased measurement flexibility, bandwidth and precision, adapting to the needs of today’s and tomorrow’s microstructures.

When incorporated in the MEMS design and test cycle, the Micro System Analyzer provides instant frequency response plots of periodic motions and precise time response plots of transient motions useful for increasing device performance. This reduces development and manufacturing costs by shortening design cycles, simplifying trouble shooting and improving yield.

Biography

Since 2017, Product Manager at Polytec GmbH, responsible for Laser Doppler Vibrometry and Surface Topography in microstructure applications.

2013-2017, Product Manager at EV Group E. Thallner GmbH, responsible for inspections systems for overlay and topography in the semiconductor production.

2008-2013, research assistant at the Institute for Microstructure Technology, Karlsruhe Institute of Technology (KIT), with focus on micro- and nano replication, equipment design and measurement technology.

2008 Interdisciplinary diploma, Dipl.-Ing. Mechatronics, from the faculties of electrical and mechanical engineering, University of Karlsruhe.

Thermal Treatments in MEMS Fabrication:Challenges and Benefits of Rapid Thermal Processing (RTP)

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Abstract

Thermal treatment in general, but also Rapid Thermal Processing (RTP) in particular, are well established processing technologies in semiconductor manufacturing [1] , [2]. Even though MEMS fabrication is using the same fundamental technologies and methods, there are new challenges coming up with new device layouts and structures.

Whereas most advanced processing technology in semiconductor device fabrication is done and available for 300 mm wafers, the highest performance requirements in MEMS fabrication are needed for 150 mm and 200 mm wafer size. As a consequence, there is a lack of equipment, addressing the technology needs of MEMS device manufacturing on relevant wafer size.

Furthermore thermal mass distribution on semiconductor device wafers is rather uniform along the wafer radius, whereas MEMS devices often exhibit areal distributions of etched trenches and holes, having a distinct influence on thermal mass and its distribution over the wafer. Especially during the non-equilibrium phase of a thermal treatment, these areal variations have a strong influence on heating rates, soak times, and maximum temperature over the wafer.

Last but not least, specific materials combinations, e.g. for contact formation, with specific properties (durability in harsh media, at elevated temperature,…) are requested in MEMS device technology, which have to be characterized and understood in terms of reaction kinetics e.g. with silicon, in terms of deposition behavior, and last but no least in terms of thermal treatment.

The present publication discusses the various influences and challenges, and introduces potential technologies addressing those challenges. Using the example of pressure sensors, the efficiency of used methods is discussed.

Biography

Dr. Juergen Niess holds a diploma on physics and a PhD with specialization in solid state physics, both from the University of Ulm, Germany. He has 20+ years of experience in rapid thermal processing (RTP) technology and equipment development with respect to Si processing as well as compound semiconductor processing. He also has several years of experience in plasma oxidation resp. nitridation and related equipment specification and development. His experience is documented through multiple papers that were authored and co-authored by him as well as a book on “rapid thermal processing and beyond”, which was edited by him. He also holds patents in the field of RTP and plasma oxidation and has several patents pending.

References:

[1] W. Lerch, J. Nieß (ed.), (2008), Rapid Thermal Processing and Beyond: Applications in Semiconductor Processing, Trans Tech Publications, Materials Science Forum, Zurich, Vol. 573-574

[2] J. Niess, S. Paul, S. Buschbaum, P. Schmid, W. Lerch, (2004), Mainstream rapid thermal processing for source–drain engineering from first applications to latest results, Elsevier, Materials Science and Engineering B , 141-150, 114-115 , European Mater. Res. Soc. Symp. Proc. 159 (2004)

New technology for inhalers and sprays for a healthier world

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medspray

Abstract

Medspray is inventor and manufacturer of innovative spray nozzles. Located at ‘Kennispark’, the business and science park of Twente University in the Netherlands, Medspray uses nano technology to create spray nozzles from silicon with tiny orifices (approximately 2 micrometer in diameter) for a fine nebulization. For reference, a human hair has a diameter of 70 microns.

Medspray is ISO 13485 certified for development and manufacturing of medical devices. The production of spray nozzles is located at Medspray in Enschede, in dedicated ISO 7 clean rooms. World wide partners assemble Medspray’s nozzles in mutually developed spray devices. In the summer of 2019 Medspray expects to make its 1 millionth spray nozzle unit, in 2020 we expect to scale further to a production of more than 1 million nozzles per month.

Medspray’s mission is based on sustainability. The use of propellants in spray cans for cosmetics and in inhalers can be completely avoided by using Medspray nozzles and simple mechanisms like a plastic pump. Current HFA pMDIs (pressurized metered dose inhalers for e.g. Asthma and COPD) have a similar $CO2$ exhaust as a car trip of 290 km!

Since the inhaler devices have entered the public domain, our nozzles also have caught the attention of other industries, such as cosmetics. Ap apparently the requirements of a spray for the pharmaceutical industry also apply for the cosmetics industry: long actuation time (multiple seconds), narrow particle size distribution, tuneable spray cone and propellant free operation.
Medspray, tiny technology for a sustainable future.

Biography

Wietze Nijdam is responsible for technology development at Medspray BV, the Netherlands. Medspray develops novel technology for liquid inhalers and spray devices, based on their proprietary micro nano technology spray nozzles. Wietze joined Medspray eleven years ago to industrialize early developments and outsource silicon.Wietze (born in 1970) has a background in silicon processing (M.Sc. Electrical Engineering, University of Twente) with specialization in perforated thin membranes. After graduation Wietze has worked more than 10 years in MEMS on development of filtration membranes and was involved in the start-up of Medspray.

Cutting-edge Plasma Dicing for wafer singulation applied to MEMS devices

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Abstract
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Abstract:

MEMS market trends are demanding dies that are thinner, smaller, and stronger. Conventional line-by-line dicing methods, such as mechanical sawing ("blade dicing") or laser dicing, are not suitable for fragile MEMS devices, both in terms of economics and reliability.

Plasma Dicing is an alternative method to overcome the many challenges of MEMS wafer singulation that are encountered during conventional line-by-line dicing methods.

Plasma Dicing for MEMS wafers utilizes plasma trench etch ("dry etch") technology and is damage-free (no chipping, no cracking), offers smoother sidewalls, is particle-free and enables high-throughput. In addition, flexible chip shape design—including round and offset chips is possible.

Plasma Dicing is performed by opening dicing streets on a mask on the wafer surface, and etching where the wafer surface has been exposed. Several masking techniques suitable for MEMS wafers that have been developed by Panasonic can be offered. The throughput of Plasma Dicing depends principally on the thickness of the wafer, and is independent from wafer size, chip size and chip shape. By utilizing Plasma Dicing for MEMS, higher throughput and higher quality than conventional dicing can be achieved. As market trends demand smaller-and-smaller chip sizes—as is typical for MEMS devices—Plasma Dicing offers many benefits when compared to those of conventional line-by-line dicing methods; especially in terms of cost savings and quality increases.

Patented techniques, processes and new equipment developed by Panasonic allow for low cost-of-ownership Plasma Dicing of MEMS wafers, and will be discussed in this paper.

Biography
James completed a degree in Mechanical Engineering from the University of Adelaide in Australia in 2006. Since then he has held various roles in Field-test Engineering, Technical Support Engineering, Project Management & Sales for different companies; mainly in the oil and gas industry. Since 2016 he has been the Business Development Manager for microelectronics at Panasonic Factory Solutions Europe. James' main targets are to establish new business in the European Back-end and Front-end Industry; especially in the field of Plasma Dicing and Dry Etching Equipment, but also Plasma Cleaning, Die-attach and Flip-chip technologies.

Advanced black resist processing and optimized lithographic patterning for novel optical MEMS devices

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Abstract

Highly functional optical materials are getting more and more attention in the photonics' applications, particularly shielding materials and IR-related materials for optical MEMS applications. As the complexity of the photonic devices is increasing together with the optical performance, advancements in the materials and according lithographic patterning are demanded. These innovative materials show promising parameters taking the advantage of micro-dispersion technologies of ultra-fine pigments and photopolymer technologies. In this paper, the advanced resist processing and parameters of a new black material designed for miniaturized photonic devices from FFEM and optimized lithographic patterning is discussed. Resist processing methods including spin and spray coating are combined depending on required optical performance.. The UV light penetration of the coated substrate with functional black resist layer in the NUV spectrum range is limited. The absorption level of the material is already significant in the upper part of the layer closer to resist surface preventing the light from transmission to the underlying resist during the exposure. This affects the final resist polymerisation. As a consequence, the resist development process becomes challenging with the risk of introducing patterning, delamination defects or not fully resolved structures. Therefore an enhanced adjustment and further precise control of the development process is necessary in order to secure overall performance capabilities. The joint collaboration of FFEM black material division and EV Group process development enabled high precision black resist processing and optimized high resolution lithographic patterning of advanced photonic devices. The goal of this paper is to present the obtained results and augmented lithographic processes established for current and future optical MEMS applications

Biography

Bozena holds a master's degree in Microelectronics from Slovak University of Technology. Prior to EVG, Bozena started her career at Schneider Electric, where she was working as a business development manager with focus on smart industry automation solutions. During that time she worked and moved within 3 subsidiaries in Europe.