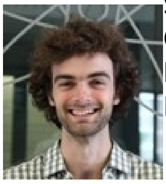
MEMS & Imaging Sensors Technology Showcase

Enabling a World of Enhanced Vision



S. Goossens
Co-founder and CTO
ICFO – The Institute of Photonic Sciences,
Barcelona, Spain

Abstract
Over the last decade, the use of cameras has expanded from photography to sensing. Most of the camera-based sensing systems convert visible light images to actionable data. However, there is an untapped wealth of information hidden in the invisible parts of the light spectrum. This invisible light allows sensing systems to increase both the quality and quantity of actionable output data by reducing ambient light interference, defying adverse ambient conditions such as fog and darkness, removing eye safety limitations and extracting compositional information.
We are developing an image sensor technology that is sensitive to visible and invisible light (Vis – NIR - SWIR, 300 - 2000 nm). The technology is based on thin-film photodetectors (graphene and colloidal quantum dots) that we demonstrated to be compatible with a CMOS back-end-of-line process. The wafer-scale process will allow the sensors to be manufactured at high volumes, posing the technology attractive to mass markets. The in-pixel gain and controllability lead to high performance levels and will allow the technology to break traditional pixel scaling laws.

Biography
tba tba

Analyze-first Architecture for Ultra-low-power Always-on Sensing

T. Doyle
CEO
Aspinity, Pittsburgh, United States

Abstract
Abstract:
Over the next five years, billions of hands-free, battery-operated, always-on sensing devices in consumer, IoT, biomedical and industrial markets will assist us in our daily lives at home and at work. As users become more dependent on such devices, they want smaller always-on products with longer-battery lifetimes. MEMS and sensors suppliers who can deliver more power-efficient solutions in ever-smaller form factors will gain a competitive edge — but how is this possible with standard signal-processing architectures?
MEMS and sensors suppliers can achieve incremental improvements in system power by improving each component in the system, but to effect great change, we need a system-level approach that achieves significant power- and data efficiency. The problem is that the current “digitize-first” system architecture digitizes all the incoming sensor data early in the signal chain — even mostly irrelevant data — before sending it to the cloud for processing. Without an alternative architectural solution, MEMS and sensors suppliers can only do so much.
A new “analyze-first” edge system architecture that uses ultra-low-power analog processing and analog neural networks now enables the detection of events — such as voice, specific acoustic triggers or a change in vibrational frequency — from raw, analog sensor data, before the data is digitized.
This “analyze-first” architecture reduces the volume of sensor data that is processed through higher-power system components (e.g., digital processors and ADCs) by up to 100x, which reduces always-on system power by 10x.
MEMS and sensors suppliers can easily integrate with the “analyze-first” edge architecture to enable smart portable products that run for months or a year instead of days or weeks.

Biography
Tom Doyle brings over 30 years of experience in operational excellence and executive leadership in analog and mixed-signal semiconductor technology to Aspinity. Prior to Aspinity, Tom was group director of Cadence Design Systems’ analog and mixed-signal IC business unit, where he managed the deployment of the company’s technology to the world’s foremost semiconductor companies. Previously, Tom was founder and president of the analog/mixed-signal software firm, Paragon IC solutions, where he was responsible for all operational facets of the company including sales and marketing, global partners/distributors, and engineering teams in the US and Asia. Tom holds a B.S. in Electrical Engineering from West Virginia University and an MBA from California State University, Long Beach.

Novel Platform to Solve 3D Nanometry Challenge

M. Utriainen
CEO
Chipmetrics Oy, Joensuu, Finland

Abstract

The future competitivity of microelectronics is based on the capability to develop components into smaller space with better energy efficiency and high performance. The 3D is a megatrend in semiconductor manufacturing eg. in the form of 3D transistors (FinFETS) and memory (3D NAND, and DRAM). High aspect ratio structures, new materials, and tighter geometries are challenges to the developers of process tools, materials, and inspection and testing.

Chipmetrics business idea is to solve the problem by the MEMS-process based special silicon test chips and on-chip characterization concepts. The starting point is the PillarHall® Lateral High Aspect Ratio (LHAR) silicon test chip innovation for ALD/CVD thin film conformality metrology developed in VTT Technical Research Centre of Finland.

Premium product is 15x15 mm PillarHall® LHAR4 test chip consisting of 18 LHAR test structures. In addition, the test chip has structures to monitor thin film stress in microscopic level. Special carrier wafer allows wafer level mapping of the thin film conformality, film properties on the trench wall and local stress.

The benefits are such as:

• Less need for destructive cross-sectional analyses and equipment investments. No sampling delay. Compatible to standard planar metrology techniques, in a simplest case by optical microscope image analysis.

• The test chip is commercially available as a product, and allows to compare 3D perfomance by any thin film material or equipment vendor.

• Wide compatibility to ALD and CVD systems and process conditions, including plasma assisted processes.

• Extremely high aspect ratios, up to 10000:1, that are not available in the market otherwise

PillarHall platform can accelerate learning about films to go beyond simple step coverage measurements and look at the detailed properties of films in high aspect ratio structures, anticipating problems early in the development process and providing detailed insights.

Biography

Mikko Utriainen received his PhD from Helsinki University of Technology in Chemical Engineering in 1999, with the topic: “Atomic Layer Deposition (ALD) thin films in chemical sensor applications”. At that time, the ALD technology was still in its infancy. Today, ALD tools are main stream in semiconductor industry. In his >25 years working career, Dr Utriainen has also managed tens of R&D project teams in industry and academy developing and commercializing sensors, instruments and automation for various applications. He has also worked as an advisor in R&D&I funding and policy in Finnish National Innovation Funding Agency and in EU-level. Furthermore, Dr Utriainen has founded 3 start-up companies to commercialize research-based deep tech innovations.

Recently, he has founded Chipmetrics Ltd, utilizing his ALD and analytical instrumentation knowledge to commercialize novel 3D conformality nanometrology concept, PillarHall®. He holds also a senior scientist position in VTT Technical Research Centre of Finland.

All-silicon ultrasonic recognition of the environment

B. Kaiser
Group Leader Reasearch and Development
Fraunhofer Institute for Photonic Microsystems
(IPMS), Dresden, Germany

Abstract
Human Machine Interface technology is rocketing in importance since ubiquitous technology is more and more trending in terms of a demand for decoupling of full consciousness from user experience. This seems true for a broader understanding of human machine interaction. A prominent example is among co-working places, where humans and robots closely interact. This symbiosis is paving the way for industry 4.0 in a broad range of industrial tasks. Other applications require thorough knowledge and even forecasting of machine status enabling predictive maintenance. MEMS based ultrasonic transducers enable detection and ranging systems that can be produced at a low unit price for high volumes. Assuming that, they may become just as available as it went to happen with inertial sensors in the past. Fraunhofer IPMS has developed the NEDMUT technology as an ultrasonic transducer for industrial applications bringing together benefits of the MEMS world
with industry digitalization needs. IPMS NEDMUT technology comprises a volume utilizing low footprint approach, ultra-low power electrostatic actuation, lead-free all silicon device, phased array, multichannel as well as combined emitter-receiver on chip capabilities.

Biography
Bert Kaiser received the M.Sc. degree from Technical University Chemnitz, Germany, in 2013 and the Ph.D. degree from Brandenburg Technical University Cottbus-Senftenberg, Germany, in 2016. His Ph.D. research was about electrostatic bending actuators, NED, in microelectromechanical systems. His main research interests include electrostatic bulk MEMS systems design, simulation, fabrication and characterization for acoustic and ultrasonic applications. His main work focus is on commercialization of the NED technology in various applications ranging from audio devices to valves for microfluidics. Since 2013 he has been working within the department of monolithically integrated actuator and sensor systems in the Fraunhofer Institute of Photonic Microsystems, Dresden, Germany. There he heads the acoustic transducers group. Main project is the all-silicon speaker and ultrasonic device technology utilizing the chips volume for sound generation. This technology is commercialized for the audio field of application in close collaboration with the spin-off Arioso Systems GmbH.

Miniature Digital IR Detectors Enabling Gas Sensing Everywhere

J. Phair
CTO
Pyreos Ltd., Edinburgh, United Kingdom

Abstract
ezPyro detectors are very stable over time ensuring a long and maintenance-free operational lifespan and combined with their high sensitivity and fast response times, ensure rapid and accurate detection of target gases. Various optical filter options are available for detecting a specific gas or gases of interest.

Pyreos Ltd, an Edinburgh-based SME, manufactures a unique MEMS PZT pyroelectric detector on silicon, which enables new sensor form factors and functionalities for thermal Mid-IR gas sensing – previously not available on the market. To address the growing need for gas sensors and digitalisation of gas sensing, Pyreos has developed a range of sensors to meet the requirements across a variety of application areas such as :
- Regulatory Greenhouse/depletive Ozone layer gas emissions monitoring
- Smart Cities, Smart Buildings (eg HVAC), Smart Agriculture/Precision Farming and the broader “Internet of Things” (IoT).
- Automotive applications (emissions, cabin monitoring, HVAC)
- Industry 4.0 (manufacturing, processing)

For example, the ezPyroTM range of Mid-IR detectors for gas sensing and concentration measurement combine the MEMS pyroelectric detector technology with a digital readout for a smallest-in-class SMD package. These sensors integrate a digital, current mode read-out that enables lower IR-emitter duty cycles, thereby saving significantly on system level power consumption, while maintaining high SNR. Programmable gain and filtering offer maximum flexibility in system design. Industry standard I2C communication enables plug-and-play connectivity to microcontrollers and allows easy tuning and calibration. ezPyro is well suited to applications with low power budgets. Current consumption is well below 100 µA when fully activated and less than 1 µA in the lowest power mode. The low power modes come with fast wake up times and the innovative and configurable wake-up by signal (eg. motion, gesture) feature.

Biography
Dr. John W. Phair, CTO, leads the development team at Pyreos Ltd, a company which develops unique thin-film pyroelectric infrared detectors.
Since graduating from the University of Melbourne with a Doctorate in Chemical Engineering with a focus on Geopolymers in 2001,
Dr. Phair has worked on fundamental microstructure characterization of cements as a Research Associate at the National Research Council in Washington, DC,
on hydrogen separation membranes at the Commonwealth Scientific and Industrial Research Organisation (CSIRO) in Australia,

and on solid-oxide fuel cell fabrication and characterization at the Technical University of Denmark in collaboration with Topsoe Fuel Cell.

Prior to joining Pyreos, he worked at poLight AS, a Norwegian company developing a MEMS autofocus lens component based on piezo technology for mobile applications.

He has over ten years of experience in optical MEMS, functional thin-film materials preparation/characterization, microelectronics, sensors and actuators with over 20 years in materials science.

XENSIV™ PAS CO_2 Sensor: New Environmental Sensor Technology: Photoacoustic Spectroscopy (PAS) Miniaturizes CO2 Sensor for High-volume Applications

A. Kopetz
Director Environmental Sensing
Infineon Technologies, Munich, Germany

Abstract

City dwellers often spend a large amount of their time indoors – whether it be in an office, at school or simply at home. Buildings, however, tend to trap air especially as the level of insulation increases for energy efficiency purposes. This could lead to the development of bad indoor air quality in case of poor ventilation, negatively impacting human comfort, productivity and health. The concentration of carbon dioxide (CO2) is a good indicator of indoor air quality.

Today´s market solutions for monitoring this odorless and colorless gas are bulky and costly or simply not good enough for widespread adoption. Leveraging its advanced MEMS microphone technology, Infineon Technologies has developed a disruptive CO2 sensor based on photoacoustic spectroscopy (PAS). XENSIV™ PAS CO2 sensor is an exceptionally miniaturized sensor designed to accommodate high-volume manufacturing; it is the first real CO2 sensor with SMD capabilities. It also includes an on-board microcontroller for easy system integration in customer products.

The innovation will enable widespread adoption of air quality monitoring in high volume applications in variety of markets such as automotive, industrial, medical and IoT.

Biography

Andreas Kopetz received his Master of Computer Science from Vienna University of Technology in 2004 and a Master of Engineering Management from Duke University, in 2005. Andreas started to work for Infineon in 2005 in the Operations & Supply Chain group covering several positions in USA, Austria and Germany. In 2010 Andreas joined Infineon's Automotive division as product marketing manager for Electric Drivetrain power modules for hybrid and electric vehicles. In 2013 he transferred to the RF & Sensors business line within Infineon's Power & Sensor Systems division. He has been substantially growing Infineon's MEMS Microphone & pressure sensor business since then, recently as Director Marketing heading the product marketing and application engineering teams. Since March 2019 he is in charge of the accelerator program for environmental sensing.