Institute of Microelectronics
A*STAR

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A*STAR IME'S CONSORTIUM TO DEEPEN CAPABILITIES IN MEMS TECHNOLOGIES FOR INDUSTRIAL INTERNET OF THINGS, AUTOMOTIVE, AND INDOOR NAVIGATION APPLICATIONS

*A*STAR IME's collaborative partnership with industry will enable the development of cutting-edge industrial-grade sensors to heighten performance and achieve cost-effectiveness for MEMS devices*

Singapore — A*STAR's Institute of Microelectronics (IME) has launched its third consortium to develop cutting-edge micro-electro-mechanical systems (MEMS) technologies. This would allow MEMS sensor devices to achieve better performance, higher power efficiency and smaller form factor.

The MEMS Consortium III comprises leading industry members Applied Materials, Coventor, Delta Electronics, GLOBALFOUNDRIES, InvenSense, SPTS Technologies, Standing Egg, ULVAC, Inc., Veeco and an electronics company. It will draw on IME's expertise in MEMS sensors and process platform capabilities to develop industrial-grade inertial sensors and pressure sensors for adoption into a wide range of products and applications, such as electronic stability control, asset tracking, unmanned aerial vehicles, automotive and wearable devices. To achieve this, they will focus on bridging the gaps in performance, cost and size between existing industrial-grade inertial sensors and current MEMS sensors.

The consortium will also develop an aluminum nitride (AlN) frequency modulated MEMS inertial measurement unit, including a 3-axis accelerometer, a 3-axis gyroscope, a pressure sensor, as well as associated AIN inertial process platform and process design kits. AlN MEMS inertial sensors have several advantages over current MEMS sensors such as noise immunity, higher sensitivity, better linearity and simpler readout circuit design. These sensors also have a high potential in meeting industrial-grade performance requirements at a lower cost and smaller footprint.

As demand for MEMS devices in consumer, automotive and industrial sectors continues to grow, the industry faces complex challenges in developing devices

with more advanced functionality, a smaller footprint and higher performance at lower cost. Research and development (R&D) in MEMS and sensor technology will be critical in addressing these challenges and paving the way for the mass adoption of MEMS devices in a wide range of applications. The MEMS market is expected to be worth more than US$22 billion by 2018.

In its second MEMS consortium, IME and its industry partners successfully developed advanced capabilities in product-oriented MEMS devices such as an energy harvester, an oscillator and a magnetometer. For details, please refer to **Annex A**.

"Our achievements in MEMS technologies are a result of close collaboration with industry, and show that technological advances are made possible through open innovation. As we leverage our combined R&D expertise and industry experience to develop innovative and cost-effective technology solutions, we will drive the mass production and commercialisation of next-generation electronic devices," said Prof. Dim-Lee Kwong, Executive Director of IME.

"GLOBALFOUNDRIES is a founding member of the MEMS consortium hosted by IME. By participating in this third consortium, we hope to partner with leaders in the MEMS industry on technology innovations to strengthen our MEMS technology portfolio, with the goal to provide broader technology capabilities and innovative solutions to our customers," said Dr. Rakesh Kumar, Senior Director for MEMS Program of GLOBALFOUNDRIES.

"It is vital to create vibrant R&D partnerships to enable faster commercialisation of innovative solutions. IME's MEMS consortia are an open innovation platform that allows us to identify and develop best in class technologies and products in the More-than-Moore and beyond Moore era," said Mr. Mo Maghsoudnia, Vice President of Technology and Worldwide Manufacturing of InvenSense.

Enclosed:

ANNEX A – MEMS Consortium II Achievements

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About the A*STAR Institute of Microelectronics (IME)

The Institute of Microelectronics (IME) is a research institute of the Science and Engineering Research Council of the Agency for Science, Technology and Research (A*STAR). Positioned to bridge the R&D between academia and industry, A*STAR IME's mission is to add value to Singapore's semiconductor industry by developing strategic competencies, innovative technologies and intellectual property; enabling enterprises to be technologically competitive; and cultivating a technology talent pool to inject new knowledge to the industry. Its key research areas are in integrated circuits design, advanced packaging, bioelectronics and medical devices, MEMS, nanoelectronics, and photonics.
For more information on IME, please visit www.ime.a-star.edu.sg.

About the Agency for Science, Technology and Research (A*STAR)

The Agency for Science, Technology and Research (A*STAR) is Singapore's lead public sector agency that spearheads economic oriented research to advance scientific discovery and develop innovative technology. Through open innovation, we collaborate with our partners in both the public and private sectors to benefit society.

As a Science and Technology Organisation, A*STAR bridges the gap between academia and industry. Our research creates economic growth and jobs for Singapore, and enhances lives by contributing to societal benefits such as improving outcomes in healthcare, urban living, and sustainability.

We play a key role in nurturing and developing a diversity of talent and leaders in our Agency and Research Institutes, the wider research community and industry. A*STAR oversees 18 biomedical sciences and physical sciences and engineering research entities primarily located in Biopolis and Fusionopolis.

For more information on A*STAR, please visit www.a-star.edu.sg.

ANNEX A

MEMS CONSORTIUM II ACHIEVEMENTS

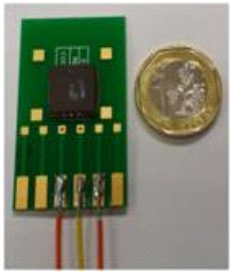
The MEMS Consortium II successfully developed advanced capabilities in product-oriented MEMS devices such as an energy harvester, an oscillator and a magnetometer.

The energy harvester which was developed for tyre pressure monitoring systems (TPMS) displays a power spectrum density of 29 mW.Hz at 20g acceleration, and a maximum power of about 0.47mW and a g-drop shock survival feature of more than 5000g of shock. It is also compact with a volume of 0.12cm^3. This device can also be used for machine health-monitoring of industrial and IoT applications.

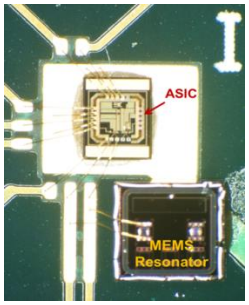
The consortium also developed a MEMS oscillator that overcomes the limitations of conventional crystal oscillators such as miniaturisation, high frequency stability and low power consumption. The MEMS oscillator uses an ultra-low power consumption of 192 mW and a high frequency AIN resonator of 358 MHz which generates low noise – important features for consumer electronics and wireless sensors in high speed telecommunication networks.

Another significant development is a cost-effective complementary metal-oxide semiconductor (CMOS) compatible magnetometer which uses Lorentz force instead of magnetic materials to measure the magnetic field. Wafer level packaging with polysilicon through silicon via (PolySi TSV) was adopted to achieve a smaller footprint. The platform allows the integration of a 3–axis accelerometer, and 3-axis gyroscope, 3-axis magnetometer and pressure sensor on the same wafer, enabling 10 DoF IMU on one chip.

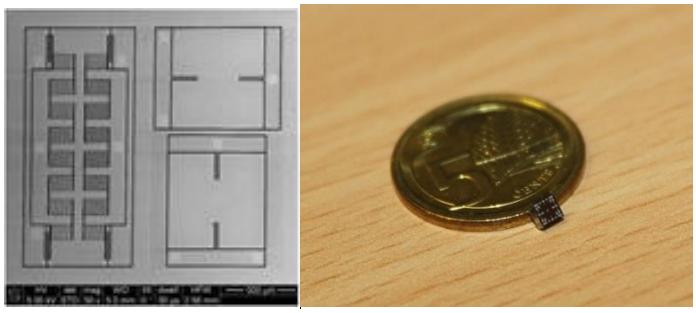
IMAGES



Energy harvester on a Printed Circuit Board



358 MHz AlN MEMS oscillator



The Lorentz force-based 3-axis MEMS magnetometer device