

## MEDIA RELEASE

23 July 2014

### A\*STAR AND INDUSTRY FORM S\$200M SEMICONDUCTOR R&D JOINT LABS

*Public-Private Partnership to drive innovative solutions for complex micro chip manufacturing*



Group Photo of Launch Ceremony with Guest-of-Honour, Mr. S. Iswaran, Minister, Prime Minister's Office, Second Minister for Home Affairs and Trade & Industry and Joint Lab Partners

**Singapore**—Four joint laboratories, representing a commitment of S\$200m between private and public sectors, were launched today between A\*STAR's Institute of Microelectronics (IME), and its 10 industry partners. The Advanced Semiconductor Joint Labs will develop and advance semiconductor technologies for future electronics markets. The industry partners involved in this international collaboration are: Applied Materials, Dai Nippon Printing, DISCO, KLA-Tencor, Mentor Graphics, Nikon, Panasonic Factory Solutions Asia Pacific, PINK, Tokyo Electron Ltd. and Tokyo Ohka Kogyo.

While expectations are for smart devices to sustain a compact form factor, consumers also expect powerful performance and low power consumption. The challenge for the semiconductor industry is to meet these needs by addressing system and integration scaling in the electronics market<sup>1</sup>. The four joint labs in lithography, wafer level packaging (WLP), metrology and assembly, will provide an integrated platform for semiconductor R&D, starting with patterning<sup>2</sup>, further development of 3D Integrated Circuits (IC)<sup>3</sup>, quality control, and finally, the assembly and high-volume manufacturing of chips. Full details of the labs' capabilities are available in **Annex A**.

The joint labs build upon the successful model of the IME-Applied Materials Centre of Excellence<sup>4</sup>. Together, the four labs will enable the development of innovative semiconductor technologies and allow partners to undertake solutions-oriented semiconductor R&D and facilitate commercialisation that is earlier, faster and cheaper. This international partnership also bears testament to the industry relevance of IME's deep research capabilities, and will encourage further development of solutions for global implementation.

Mr Lim Chuan Poh, Chairman of A\*STAR, said, "The launch of IME's Advanced Semiconductor Joint Labs today is an excellent example of public-private partnership under an open innovation framework. I am pleased that A\*STAR IME has entered into this strategic partnership with many leading global industry players to capture new growth opportunities for Singapore and the region. The launch of the Advanced Semiconductor Joint Labs reaffirms A\*STAR's deep capabilities and strong infrastructure in the R&D ecosystem to serve the growing needs of the semiconductor industry."

Professor Dim-Lee Kwong, Executive Director of IME said, "These joint labs further demonstrate our ability to build a global network of partnerships that stretch across the supply chain. These collaborations will encourage semiconductor R&D that is relevant for industry, and provide solutions for a rapidly evolving global electronics market. Through this integrated platform, our

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<sup>1</sup> This refers to the shrinking of both chips and chip packaging, while ensuring that more functions can be integrated onto a chip.

<sup>2</sup> In semiconductor manufacturing, lithography is the patterning of microchips, and is considered a critical first step in ensuring chips are patterned robustly.

<sup>3</sup> In 3D chip packaging, multiple chips can be stacked on top of each other and connected with wiring that runs vertically through the stack (called through-silicon vias or TSVs). This reduces package size, decreases power consumption and increases data bandwidth.

<sup>4</sup> The Applied Materials and IME Centre of Excellence in Advanced Packaging was opened in 2012, and combines Applied Materials' leading-edge equipment and process technology with IME's leading research capability in 3D chip packaging.

partners can leverage A\*STAR IME's technologies and expertise to develop innovative technologies and products to address challenges in the semiconductor industry."

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### **Quotes from Industry Partners:**

*Gary Dickerson, CEO, Applied Materials:*

"At Applied, we believe that broad collaboration generates creative solutions that enable major technology inflections, and our partnership with A\*STAR IME is an outstanding example," said Gary Dickerson, president and CEO of Applied Materials. "By combining great ideas and capabilities from industry and research institutes, we are accelerating innovation needed to bring next-generation technology to market, faster and more cost-effectively."

*Rick Wallace, President and Chief Executive Officer, KLA-Tencor:*

"Our collaboration with A\*STAR IME will strengthen our knowledge of future process control trends, driving technology development for our next-generation tools. We look forward to working with IME on advanced semiconductor research and to developing yield management strategies that can be shared with semiconductor manufacturers."

*Kazuo Ushida, President and Representative Director, Nikon Corporation:*

"Through this collaboration with A\*STAR IME, Nikon will gain knowledge of future process technology and total solutions, which will be important for our lithography system development. We are very excited to partner with one of the most advanced and established institutes in the Asia region."

*Katsuhiko Omoto, President, Panasonic Factory Solutions Co., Ltd.:*

"Panasonic Factory Solutions Co., Ltd. is continually conducting extensive research to develop and create technologies that can help its customers to achieve competitive edge in productivity and create value added solutions to their customers. We are confident that the strategic alliance with A\*STAR and Joint-Lab members will result in the development of advanced flip chip bonding technologies that will support next generation's semiconductor packaging."

*Dr. Gishi Chung, Senior Vice President and General Manager of SPE Marketing & Process Development Division of Tokyo Electron Ltd.:*

“It is increasingly important to make the innovation by collaborating with consortia, academia and industry. Cost-effective technology, past and future industry demand, is always created by the innovation. This collaborative platform with A\*STAR IME will play a key role to make both the innovation and the global ecosystem.”

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**Enclosed:**

**ANNEX A** – About the Advanced Semiconductor Joint Labs

**ANNEX B** – About the Advanced Semiconductor Joint Lab Members

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**About the 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, 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 about IME, please visit [www.ime.a-star.edu.sg](http://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 fosters world-class scientific research and talent to drive economic growth and transform Singapore into a vibrant knowledge-based and innovation driven economy.

In line with its mission-oriented mandate, A\*STAR spearheads research and development in fields that are essential to growing Singapore's manufacturing sector and catalysing new growth industries. A\*STAR supports these economic clusters by providing intellectual, human and industrial capital to its partners in industry.

A\*STAR oversees 18 biomedical sciences and physical sciences and engineering research entities, located in Biopolis and Fusionopolis, as well as their vicinity. These two R&D hubs house a bustling and diverse community of local and international research scientists and engineers from A\*STAR's research entities as well as a growing number of corporate laboratories.

For more information on A\*STAR, please visit [www.a-star.edu.sg](http://www.a-star.edu.sg).

**ABOUT THE ADVANCED SEMICONDUCTOR JOINT LABS:**

**1) The Wafer Level Packaging Joint Lab:**

The Wafer Level Packaging (WLP) Joint Lab will focus on the development of advanced interconnect solutions and state-of-the-art equipment to bridge the increasing I/O interconnect gap between shrinking silicon geometries and printed circuit boards. The Joint Lab will develop innovative, and cost-effective interconnect solutions to enable logic and memory integration for low-power mobile devices and high-performance applications such as data centres. Cost-effective WLP solutions will be timely in catching the demand for wafer level packaging IC chips. According to Yole<sup>5</sup>, in 2017, 23% of overall semiconductor IC wafers to be manufactured with packaging features are expected to be processed on wafer level scale.

Joint lab partners: Applied Materials, KLA-Tencor, Nikon and Tokyo Electron Ltd.

**2) The Advanced Lithography Joint Lab:**

The Advanced Lithography Joint Lab seeks to develop advanced optical lithography technology used in the manufacturing of semiconductor chips. It will enhance capabilities for improving resolution, process window and control to mitigate device failure that is increasingly important due to chip shrinkage. In particular, it will focus on the development of lithography techniques such as direct self-assembly (DSA) and double/multiple patterning to facilitate scaling of ArF Deep Ultraviolet (DUV) dry and immersion down to 14nm and beyond, targeting advanced applications including logic, high density memory, embedded non-volatile memory, high-speed electronics and nanophotonics, and nano-electromechanical systems(NEMS).

Joint lab partners: Dai Nippon Printing, KLA-Tencor, Nikon, Mentor Graphics, Tokyo Ohka Kogyo and Tokyo Electron Ltd.

**3) The Metrology Joint Lab:**

The Metrology Joint Lab will provide and develop necessary solutions in inspection and process controls to anchor developmental processes arising from

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<sup>5</sup> Source: [http://www.semi.org/eu/sites/semi.org/files/docs/5\\_Yole\\_Nanium%20Workshop.pdf](http://www.semi.org/eu/sites/semi.org/files/docs/5_Yole_Nanium%20Workshop.pdf)

the wafer level packaging and lithography joint labs. This will enable design and process optimization of integrated circuits for shrinking technology and cost-effective manufacturing solutions.

Joint lab partner: KLA-Tencor

#### **4) The Assembly Joint Lab:**

The Assembly Joint Lab will focus on the development of bonding/de-bonding, fusion bonding, thermo-compression bonding and reflow bumping technologies to address existing issues such as high throughput and particle-free de-bonding, high throughput Chip on Wafer (CoW) for 2.5D/3D integration of ICs, and high-accuracy low-temperature wafer-level bonding. Tools and processes will be developed for high volume manufacturing of advanced multi-functional 2.5D and 3D ICs.

Joint lab partners: DISCO, Panasonic Factory Solutions Asia Pacific, PINK and Tokyo Electron Ltd.

**ABOUT THE ADVANCED SEMICONDUCTOR JOINT LAB MEMBERS:**

**Applied Materials**

Applied Materials, Inc. (Nasdaq: AMAT) is a global leader in precision materials engineering solutions for the semiconductor, flat panel display and solar photovoltaic industries. Our technologies help make innovations like smartphones, flat screen TVs and solar panels more affordable and accessible to consumers and businesses around the world. Learn more at [www.appliedmaterials.com](http://www.appliedmaterials.com).

**Dai Nippon Printing**

DNP [Dai Nippon Printing Co., Ltd.] is a world-class comprehensive printing company with 1.449 trillion yen in annual revenues and approximately 40,000 employees. Based in Tokyo, Japan, DNP offers a broad range of products and services for publishing, commercial printing, smart cards, networking, and electronics components, among others. Its products in the electronics field include color filters and other components for LCDs, photomasks, and semiconductor-related components. In the photomask market, DNP is a world leader, utilizing its time-honored printing techniques and know-how in the fabrication of cutting-edge photomasks.

**DISCO**

DISCO Corporation provides applications and products built upon our advanced core technologies of Kiru (cutting), Kezuru (grinding), and Migaku (polishing), which have been our focus since our founding in 1937. Complementing traditional dicing and grinding technology using diamond blades and wheels, we also offer laser based dicing applications to provide for a variety of needs. At the IME Joint Lab, DISCO's technology makes the production of die with high strength and high quality a reality even for the processing of ultrathin wafers using our SDBG technology (Stealth Dicing Before Grinding). In addition, we also provide various types of solutions for TSV processing and 3D/2.5D package processing.



**KLA-Tencor**

KLA-Tencor Corporation, a leading provider of process control and yield management solutions, partners with customers around the world to develop state-of-the-art inspection and metrology technologies. These technologies serve the semiconductor, LED and other related nanoelectronics industries. With a portfolio of industry-standard products and a team of world-class engineers and scientists, the company has created superior solutions for its customers for more than 35 years. Headquartered in Milpitas, Calif., KLA-Tencor has dedicated customer operations and service centers around the world.

For more information on KLA-Tencor, please visit [www.kla-tencor.com](http://www.kla-tencor.com).

**Mentor Graphics**

Mentor Graphics Corporation is a world leader in electronic hardware and software design solutions, providing products, consulting services and award-winning support for the world's most successful electronic, semiconductor and systems companies. Established in 1981, the company reported revenues in the last fiscal year in excess of \$1.15 billion. Corporate headquarters are located at 8005 S.W. Boeckman Road, Wilsonville, Oregon 97070-7777.

For more information on Mentor Graphics, please visit [www.mentor.com](http://www.mentor.com).

**Nikon**

Nikon has been a pioneer in optical technology markets worldwide since its inception in 1917. Today, we offer a wide range of products utilizing advanced technologies, from consumer optics such as digital cameras, camera-related products and binoculars, to industrial precision equipment including Semiconductor and flat panel display (FPD) lithography systems, microscopes and measuring instruments.

For more information about Nikon, please visit [www.nikon.com](http://www.nikon.com).

**Panasonic Factory Solutions Asia Pacific**

Panasonic Factory Solutions Asia Pacific (PFSAP), a registered business of Panasonic Asia Pacific Pte. Ltd., is a total solutions provider, delivering innovative solutions that strongly add value to its customer production and process, thereby enhancing customers' throughput and production.

PFSAP has manufactured Auto Insertion (AI) machine in-house since 1989. Over the years, PFSAP has added Surface Mount Technology (SMT) machines and Microelectronics machines to its product range. More recently from 2011, PFSAP acquired the manufacturing capabilities to develop Microelectronics machines in-house through technological transfer from Panasonic Factory Solutions Co., Ltd. in Japan.

For more information about PFSAP, please visit [www.pfsap.panasonic.com.sg](http://www.pfsap.panasonic.com.sg).

## **PINK**

As a world market leader for special vacuum plants and systems PINK supplies customer designed products since almost 30 years. PINK GmbH Thermosysteme - founded by Friedrich Pink - has its seat in Wertheim / Germany and about 80 employees now. The versatile and all-embracing product range includes vacuum reflow ovens in different sizes for void-free reflow bumping and bonding, low-pressure plasma systems for surface activation, cleaning, etching and coating as well as static and dynamic dryers for gentle drying, tempering and storing of high-sensitive components.

In the past years, the family business PINK has grown steadily and successfully due to continuous product improvements and consequent customer orientation. PINK operates internationally with a network of agencies in all major markets and is a worldwide supplier of customized plants and systems.

## **Tokyo Electron Ltd**

Tokyo Electron Ltd., established in 1963, is a leading global supplier of innovative semiconductor production equipment (SPE). Product lines include coater/developers, thermal processing systems, etch systems, single wafer deposition systems, surface preparation systems, gas cluster ion beam technology, and test systems. The company also handles flat panel display (FPD) production equipment, employing the expertise it has developed in the SPE field. The bulk of Tokyo Electron Ltd.'s SPE and FPD production equipment has captured a large share of the global market. To support the company's diverse product base, Tokyo Electron Ltd. has a global network of strategically located research & development, manufacturing, sales, and service locations in 19 countries in North America, Europe and Asia.

**Tokyo Ohka Kogyo**

Tokyo Ohka Kogyo (TOK) Co., Ltd. was established in 1940. It has subsidiaries in Singapore, Taiwan, Europe, USA, Korea and China. TOK's main business domain lies in the manufacturing of materials, mainly photoresists and high purity chemicals for photolithography process of semiconductor and liquid crystal display. Microprocess technology, such as photoresist, is supporting advancement in the electronics field. From micrometer to cutting-edge nanometer features, TOK provides optimal photoresists and related equipment tailored to the production of various semiconductor devices.