Agency for Science, Technology and Research
SINGAPORE

**PRESS RELEASE**
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## BRINGING THE WORLD TO YOUR HOME AT THE END OF A FIBRE

It may soon be possible to attain ultra high speed connectivity at our homes, with the technologies developed at the research institutes of A*STAR (Agency for Science, Technology and Research).

Optical fibre cables, which enable information to be transmitted at high speeds, are now widely used in Singapore by various internet service providers. However, these cables are never laid all the way to our homes, due to limitations such as size of equipment and cost.

A*STAR's research institutes, namely the Institute of Materials Research and Engineering (IMRE), the Institute of Microelectronics (IME) and Singapore Institute of Manufacturing Technologies (SIMTech), have been developing technologies that can be applied to improve data transmission methods and miniaturise equipment. Such technologies will enable optical fibre to be brought into our homes at lower cost. The range of research work includes ultra-thin wafer manufacturing technologies as well as packaging and integration of optical components.

"A*STAR's research institutes (RIs) are constantly pushing the frontiers of research, to achieve new possibilities. For example, since April 2001, A*STAR's RIs have been collaborating with NUS and NTU through the Optical Networking Focused Interest Group, or ONFIG, to explore optical access network

technologies by pulling together competencies in photonics, electronics and software," says Prof Chong Tow Chong, Executive Director of A*STAR's Science and Engineering Research Council.

"There are many opportunities for technology innovation in the semiconductor industry. The integration of capabilities of A*STAR's research institutes creates many opportunities for collaboration with the industry. Industry can tap on A*STAR created technologies to create innovative solutions and products to meet future needs," said Ms Emily Tan, Senior Vice President, Science and Engineering Division & Incubation and Spin-off Management Division of Exploit Technologies Pte Ltd (ETPL) – the commercialisation arm of A*STAR.

**Ultra – Thin Wafer Manufacturing Technologies**

IME has developed the capabilities to thin different classes of silicon wafers down to the thickness of a single strand of hair. Coupled with SIMTech's Automated Wafer Inspection System, which can be used to detect wafer defects, scratches, chipouts, surface particles etc, mass manufacturing of ultra thin wafers to be used in miniaturised semiconductor components will be made possible.

**Packaging and Integration of Optical components**

By combining photonic devices based on groups III-V semiconductors (such as gallium Arsenide and Indium Phosphide), with movable mechanical structures, IMRE is developing technologies that could produce / guide light on micrometer dimension. This ability to combine light detection and emission feature at the micro-dimension levels would pave ways towards novel photonic devices with the flexibility of tuning optical signals.

Technologies that support the peripheral products, such as display screens have also been developed by IMRE. The Top Emitting Organic Light-

Emitting Devices (TOLED), which produce high visibility by self-luminescence, has the potential to be used in thin flexible plastic substrates of display screens.

These enabling technologies are displayed at the SEMICON Singapore 2004 exhibition from 4 – 6 May 2004. A*STAR's booth is located at Suntec City Convention Centre Hall 401, Booth 2210 – 2214. A list of technologies showcased by A*STAR research institutes is attached in Annex B.

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## Annex A: Organisation Profile

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

A*STAR's mission is to foster world-class scientific research and talent for a vibrant knowledge-based Singapore. The Agency is organised into four arms: two research councils, the Biomedical Research Council (BMRC) and the Science and Engineering Research Council (SERC), a Corporate Planning and Administration Division (CPAD) and a commercialisation arm, Exploit Technologies Pte Ltd (ETPL).

The Science and Engineering Research Council (SERC) funds and oversee 7 public research institutes in areas such as chemical sciences, materials, high performance computing, information technology and communications, manufacturing technology, microelectronics and data storage.

For more information, please visit: **www.a-star.edu.sg**

### About the Institute of Microelectronics (IME)

The Institute of Microelectronics (IME) is a member of the Agency for Science, Technology and Research (A*STAR). Established in 1991, its mission is to increase value-add to the electronics industry in Singapore by engaging in relevant R&D in strategic fields of microelectronics; supporting and partnering the electronics industry; and developing skilled R&D personnel. Its key research areas are in integrated circuits and systems; semiconductor process technologies and microsystems, modules and components.

For more information, please visit: **www.ime.a-star.edu.sg**

### About the Institute of Materials Research and Engineering (IMRE)

The **Institute of Materials Research and Engineering (IMRE)** is a member of the Agency for Science, Technology and Research (A*STAR). Established in 1996, its mission is to create materials knowledge, develop human capital and to transform technology through innovative research.

IMRE undertakes research in selected fields of materials science and engineering, including optoelectronics, nanomaterials, chemicals and polymers. The research institute's innovations and discoveries are constantly being explored to further the applications of advanced materials and processes.

For more information, please visit: **www.imre.a-star.edu.sg**

### About the Singapore Institute of Manufacturing Technology (SIMTech)

The **Singapore Institute of Manufacturing Technology (SIMTech)** is a member of the Agency for Science, Technology and Research (A*STAR). Established in 1993, its mission is to enhance the competitiveness of the local manufacturing industry.

SIMTech contributes to the competitiveness of the Singapore industry through generation and application of advanced manufacturing technology and development of human capital. It has collaborated with multinational and local companies in the electronics, semiconductor, precision engineering, aerospace, logistics, marine and other sectors.

For more information, please visit: **www.SIMTech.a-star.edu.sg**

**About Exploit Technologies Pte Ltd (ETPL)**

**Exploit Technologies Pte Ltd (ETPL)** is the commercialisation arm of the Agency for Science, Technology and Research (A*STAR). Its charter is to identify, protect and exploit promising intellectual property (IP) created by the Research Institutes under A*STAR. This includes facilitating the IP management process, protecting inventions through patents and copyrights, evaluating A*STAR's IP, identifying their strengths and the markets that they can serve, and working with companies to commercialise the technologies.

For more information, please visit: **www.exploit-tech.com**

## Annex B  Technology Showcased at SEMICON 2004

### Institute of Microelectronics (IME)

**Technology 1:  Ultra Thinning of Silicon Wafers**
IME has developed Novel methodologies to ultra thin silicon wafers taking into consideration the increasing wafer sizes from 6" to 12" by low cost mechanical backgrinding and polishing method. IME has patented the method to ultra thin bumped wafers down to <100µm and MEMS wafers down to 200µm. IME's method can handle wide range of wafer size, bump size and bump distribution coupled with higher backgrinding and polishing yield. MEMS wafer is thinned by using reusable carrier concept, demonstrating MEMS wafer thinning for the first time in the world by mechanical backgrinding and polishing method.

**Technology 2:  Wafer level packaging**
The predominant single chip packaging solution for the future is wafer level packaging. Currently this technology is proven more to memory and RF devices with wafer level off chip interconnect pitch in the order of 500microns. Bringing wafer level packaging technology for high I/O Integrated Circuits (IC) necessitates design and development of finer pitch (less than 150 microns) at wafer level off chip interconnects. To stay ahead of industry and to address some of the above research challenges, IME has joined forces with NUS and Georgia Institute of Technology (USA) in a significant research project entitled **Nano Wafer Level Packaging**. This three year project currently in its final year in 2004 has already demonstrated complete wafer level interconnects of 100 microns pitch and currently working at the 20 micron pitch interconnects using nano structured materials.

**Technology 3:  Silicon micromodule**
IME's research activity on **Silicon Micromodules (SIMM)** is a significant and innovative demonstrator of stacked module concept and acts as a platform technology for the development of silicon based System in Package technologies. The key enabling technologies such as wafer level stacking, through hole interconnections, wafer thinning and stacking, flip chip onto stacked wafers, Coaxial vias for RF applications , micro channel structures for enhanced thermal management were all developed as a part of this successful research program. This research has disclosed 5 inventions and published several papers. This research activity has resulted in two successful industry consortia attracting 15 global industry partners.

**Technology 4:  Optical ICs and Transceivers**
As optical networking technology demands move from gigabit/sec to terabit/sec for long haul and core networks, and from megabit/sec to gigabit/sec for access networks, the modules, backplanes and interconnects pose new challenges. The key focus of this research area is to integrate optical, RF and digital functions using system in package and to develop enabling technologies such as silicon optical bench.

IME is equipped with core competencies in RF design, optical design, and opto-electronic module development, and is currently engaged in the implementation of novel chip-to-chip and board-to-board optical interconnects.

Optical Networking Focused Interest Group (ONFIG), formed in April 2001, aims to explore optical access technology by pulling together competencies in photonics,

electronics and software. Established R&D participants of ONFIG comprise research institutes such as the Institute of Microelectronics (IME), Data Storage Institute (DSI), the Institute of Materials Research & Engineering (IMRE), the Institute for Infocomm Research ($I^2R$), the Singapore Institute for Manufacturing Technologies (SIMTech), the National University of Singapore (Electrical Engineering) and Nanyang Technological University (Microengineering, Photonics Group).

## Institute of Materials Research and Engineering (IMRE)

### Technology 1: TOLED

Organic light-emitting devices (OLEDs) can produce high visibility by self-luminescence. They do not require back lighting, which is necessary for liquid crystal displays and they can be fabricated into lightweight, thin and flexible displays.

### Technology 2: Passive Matrix Organic Light Emitting Devices

Handphones typically have a liquid crystal display to show text and graphics, and more recently, models have appeared with a sub-display on the outside. However, as the consumer starts to demand better quality images as a result of camera phones and video streaming, so the display must improve too. In the future, these displays will be brighter, more vivid organic light emitting diode (OLED) devices. The passive matrix display exhibited here is a research and development example of an OLED display that may replace the sub-display of such a handphone. Although only one colour at the moment, in the future these will be full colour, use less power than the LCD equivalents and eventually mechanically flexible so that they may be curved or even rolled up. Some advantages of OLEDs over LCDs are:

- Increased brightness
- Faster response time for full motion video
- Lighter weight
- Greater durability
- Broader operating temperature range
- Thinner, space saving packaging

### Technology 3: Optical MEMs based on III-V materials

Micro-Opto-Electro-Mechanical Systems (MOEMS) are devices with static/movable components that are built from materials that are 80 times thinner than your hair and have the additional ability to produce/guide light. These materials that emit/detect light are known to have created tremendous impact in photonic applications such as laser and LEDs, used in compact-disc systems, light display boards and in optical communication.Traditional approaches to MEMs technology have been on silicon or polymer-related materials using the standard IC processing techniques, which are used to produce chips for computers and other electronic systems. Silicon MEMs have the limitation of being a pure mechanical- electrical in nature hence in order to incorporate optical functionality along with MEMs, III-V based semiconductors are considered in realising novel photonic devices.

The ability to combine light-emission and detection features at the micro-dimension level would provide us with novel photonic device integration and flexibility of tuning optical

signals in the present communication network. **Tunable PDs are cost-effective and find use in Wavelength Division Multiplexing (WDM) communication systems, spectroscopic applications and in wavelength measurement.**

## Singapore Institute of Manufacturing Technology (SIMTech)

**Technology 1: Device Manufacturing**
SIMTech provides complete solutions in **substrate design and fabrication** - electrical and thermal designs, high-density organic and Low Temperature Co-fired Ceramics (LTCC) substrate fabrication, wafer bumping processes and verification of high performance interconnects as well as digital, mixed-signal wireless and broadband optical applications. These research efforts are made jointly with the A*STAR Micro-System Packaging Programme.

Its research activities in **micro/nano and systems design and fabrication** include micro/nano-fabrication processes; wafer level packaging consisting of wafer bonding, wafer bumping and vacuum/hermetic sealing for various operating environments.

**Technology 2: Equipment Development**
In this area, SIMTech is showcasing **nano-scale inspection technologies** for precision dimensional measurement, **ultra-precision motion technology** that enables motion systems to achieve nanometer level motion resolution and accuracy for a large travel of a few hundred millimetres as well as the **micro-digital image speckle correlation system** for real-time/in-situ whole field deformation measurements in microelectronics and microelectromechanical system (MEMS) packages with high sensitivity.

SIMTech spearheads the development of fibre optics sensors and the associated optical signal processing technology for precision measurements with nano-resolution. Various **all-fibre optics components and fabrication** and the **athermal fibre bragg grating** are showcased.