Agency for Science, Technology and Research
SINGAPORE

Press Release

For Immediate Release

7 September 2004

A*STAR RESEARCH LABS SHOWCASES/UNVEILS CUTTING EDGE TECHNOLOGIES FOR THE ELECTRONICS INDUSTRY AT GLOBALTRONICS 2004

At Globaltronics 2004, the Agency for Science, Technology and Research (A*STAR) is showcasing a suite of cutting edge technologies and capabilities that will yield potential cost savings, greater efficiency and reliability for products in the electronics and high precision industries. Participating at the Globaltronics 2004 are several of A*STAR-funded public sector research institutes which have core competencies in optoelectronics, micro-electro-mechanical systems (MEMS), semiconductor and design research. A*STAR's commercialisation arm, Exploit Technologies Pte Ltd (ETPL) which plays a key role in transferring technologies from A*STAR's research institutes to the local companies will also be present.

"The electronics industry continues to face increasing pressures and complexities of global competition. Scientific and technological discoveries will be key to creating new knowledge and intellectual property for companies in this cluster to generate innovative products so as to remain relevant in the regional and global economy. A*STAR's research institutes are constantly pushing the frontiers of research and collaborating in areas that will support Singapore's economic competitiveness. " says Prof Chong Tow Chong, Executive Director of A*STAR's Science and Engineering Research Council.

"Exploit Technologies creates opportunities for companies to tap on the wealth of intellectual assets generated by the A*STAR-funded public research institutes. Companies can benefit from these intellectual assets to create or improve products and processes. By being at the cutting edge of technology and moving up the innovation ladder, companies can build their competitive advantage and create new markets." 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.

Cooling the heat from high-powered electronics and optoelectronics

A*STAR's Singapore Institute of Manufacturing Technology (SIMTech) and a local start-up, Trans-Thermal (TT), have jointly developed a cost effective, advanced cooling solution to manage heat dissipated from miniature electronics and optoelectronics devices. With assistance from ETPL's Commercialisation of Technology (COT) fund, SIMTech was able to harness the results of their R&D findings and develop a marketable prototype with Trans Thermal, which the latter will license and bring to market

The novelty of this solution lies in the integration of a micro heat pipe module, a thermal electric cooler (TEC) and a ceramic platform into a single package. The heat pipe module allows for faster response time, enabling improved temperature control and much higher thermal conductivity so that more heat is dissipated. (see Annex 1)

Dr Lim Khiang Wee, Executive Director, SIMTech said: "This successful collaboration underscores SIMTech's partnership with innovative local enterprises. We share our technological expertise and R&D infrastructure to help Singapore local enterprises grow."

The partners developed a fabrication and integration process that allows the TEC to have a lower profile (below 1.0mm in height), a smaller area (3mm square) and a higher density of elements per unit area. The low profile TEC in combination with a micro heat pipe embedded in Low Temperature Co-fired Ceramics can provide cooling for lasers used in optical transceivers.

Said Dr Bill Freeman, Chief Technology Officer, Trans-Thermal: "As a local start-up with limited capital and technological resources, we benefit from our partnership with SIMTech and ETPL. We were able to develop the advanced cooling solution by integrating several kinds of substrates into a single package. The partnership accelerates the time to market, critical in the electronics industry and to start-ups."

The product will be ready for commercialisation in end 2004. It will be made available through licensed distribution and directly from Trans-Thermal.

Wafer Level Super Stretched Soldering – Optmising cost and reliability of interconnects

The predominant single chip packaging solution for the future is wafer level packaging. However, the connectivity and mechanical properties of the chip, as a result of the adhesion process between chip and wafer has always been an area of great concern. Researchers at A*STAR's Institute of Microelectronics (IME) conceived the idea of generating stretched solder columns (bumps) at the wafer level to tackle the sensitivities of chips and wafers during the soldering process, and to preserve connectivity and mechanical properties.

Enabling zoom function on mobile phone cameras with FluidLens technology

Given the physical constraints of mobile phones, it may sound impossible to enable a mobile phone camera to zoom and focus. A*STAR's Institute of Materials Research (IMRE) has developed optical lenses that use water contained in fluidic reservoirs to achieve dynamic focusing in much the same way as a human eye focuses on objects far and near.

The adjustment of the focal length of the "liquid lens" by changing the radius of curvature at the liquid-air interface mimics the focusing mechanism of the human eye. This is particularly useful in compact, small optical devices, where a non-mechanical focusing approach with the least moving parts, is preferred because of the limitations of space and size. The "liquid lens", termed FluidLens, helps reduce the size of optical components and at the same time increases the precision of the optical device.

New lead-free solder alloy for a greener environment

Lead is a highly toxic substance and if exposed beyond certain limits, can cause detrimental effects to the human body. Due to the harmful effects of lead, many countries have started or plan to implement legislation that would require lead-free products. For example, the European Union will be issuing a ban on lead with effect from 1 July 2006.

One of the major sources of lead is in the form of lead based solders found commonly in commercial appliances and computers. To meet the challenges of the impending ban on lead-based solders, A*STAR's Institute of High Performance Computing (IHPC) has invented new lead-free alloys through simulation-based Digital Materials Design techniques. With support from ETPL's Commercialisation of Technology Fund, these formulations have been verified by experiments and are now ready for companies to evaluate for their use. These alloys will serve as a replacement for the current, widely-used high operating temperature lead-free solder alloys. This is because the newly invented lead-free alloys have an operating temperature of 197^{0}C which is 20^{o}C lower than the widely- used Tin-Copper-Silver alloys. Businesses will benefit as the new alloys will lower the soldering process temperature as well as production costs.

A*STAR's exhibits are located at **Hall 401 – 404 (Booth #Q28)**. GlobalTRONICS 2004 will be held from September 7 to 10, at Suntec Singapore International Convention and Exhibition Center. Opening hours are as follows:

Sep 7	– 10:30am to 6:00pm
Sep 8-9	– 10:00am to 6:00pm
Sep 10	– 10:00am to 4:00pm

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Annex A: Organisation Profile
Annex B: Technology Showcased at GlobalTRONICS 2004

ANNEX A: Organization 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 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

About the Institute of High Performance Computing (IHPC)
The Institute of High Performance Computing (IHPC) is a member of the Agency for Science, Technology and Research (A*STAR). IHPC was established in 1998 following the merger between the Centre for Computational Mechanics (CCM) and the National Supercomputing Research Centre (NSRC). The research institute's mission is to enhance Singapore's global competitiveness through the innovative research and human capital development in leading-edge computational science and engineering for modelling, simulation and visualisation.

For more information, please visit: **www.ihpc.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 the 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, automotive, aerospace, marine, logistics and other sectors.

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

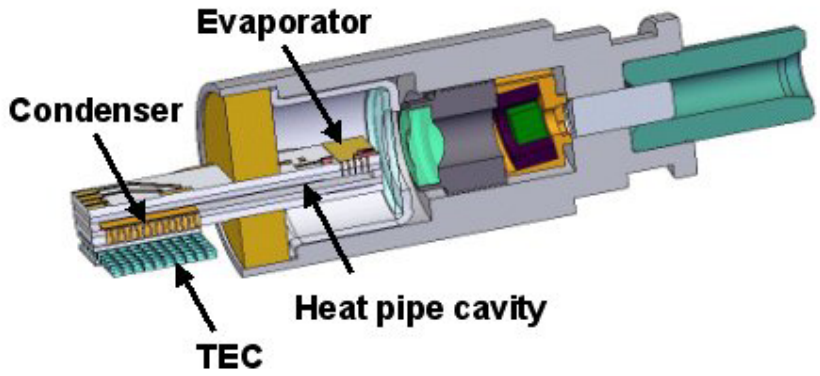
About SIMTech's Joining Technology Group
Micro-joining and multi-functional substrate design and fabrication are the foci of Joining Technology Group (JTG) research work. The driving force for the research activities in JTG comes from the need to develop cost effective integration platforms for micro-nanosystems for the manufacturing industry. The group has strong expertise and comprehensive facilities in substrate design and fabrication, microstructuring, wafer bonding, wafer-level packaging, wafer bumping, hermetic sealing, soldering and advanced packaging.

About Trans-Thermal
Trans-Thermal is a local start-up engaged in heat management in miniature systems. Incorporated on 15 March 2004, the company is targeting its advanced thermal management solutions to the computer processing unit cooling and the fiber transceiver markets.

For details, please visit: www.trans-thermal.com

ANNEX B – Technologies showcased at GlobalTRONICS 2004

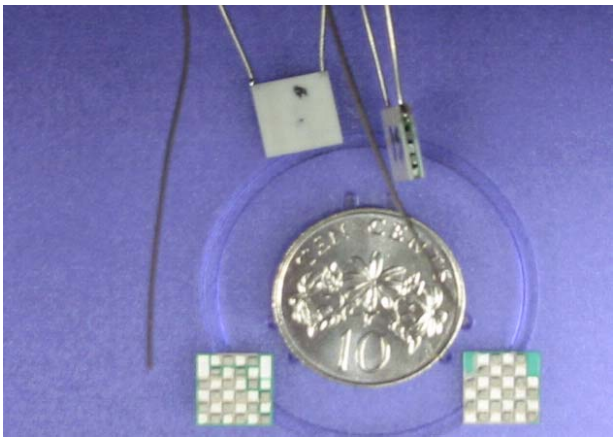
Singapore Institute of Manufacturing Technology (SIMTech)
Advanced thermal management solution for use in fiber optic transceivers



How it works:

- Liquid in micro channels are wicked towards the heated area in the heat pipe
- Heat dissipates as liquid evaporates
- Hot vapour travels by pressure to cooler area of the heat pipe
- Heat pumped away from heat pipe to the environment by thermal electric cooler (TEC)
- Vapour condenses in the heat pipe on micro channels

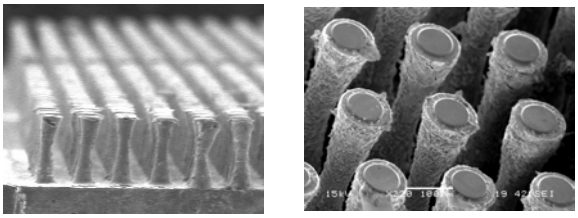
Size of SLIM-TECs compared to a 10-cent coin



The Institute of Microelectronics (IME)
Wafer Level Packaging – Super Stretched Solder

The thermal cycling reliability of the interconnection between the IC chip and the interposer or between the IC chip and the printed circuit in a flip chip assembly has always been an area of great concern. Underfill material is being used currently as reinforcement by the industry. However it carries a heavy penalty due to (1) the high cost of the underfill material and the underfilling process; (2) the presence of the organic underfill between the IC chip and the interposer compromises the moisture sensitivity and autoclave reliability of the flip chip assembly; and (3) the strong coupling between the IC chip and the organic substrates imposes extreme stress in the metallisation layers of the IC chip. Condition (2) has become critical with the adoption of the lead-free solder and the associated higher reflow temperature that seriously degrades the moisture sensitivity performance of the flip chip assembly. Condition (3) is critical for IC chip that uses the advanced low-k dielectric layer which is prone to delamination. Hence, there is strong motivation to eliminate the underfill materials altogether and alternative schemes for tackling the thermal cycling reliability of the interconnection is desired.

An idea for generating stretched solder columns (bumps) at the wafer level has been invented and the results is depicted in figure below



Arrays of free-standing stretched solder on silicon

The fatigue reliability of the super stretched solder has been assessed using a specially designed micro-fatigue tester. The fatigue life of the conventional bump has been increased by 60 times when the aspect ratio of the bump is 2.8 and 140 times when the aspect ratio of the bump is 3.9. This is as good as that offered by the use of underfill, while eliminating the undesirable reliability problems associated with the use of underfill.

The Institute of High Performance Computing (IHPC)
Lead-free solder alloy

The use of lead-free soldering is driven by the increased concern about the impact of lead on health and the environment. In the USA, the electronics manufacturing industry has come to a consensus view that the ultimate abandonment of tin-lead solders with the Lead exposure ACT (S.729) and the Lead Tax Act (H.R.2479, S.1347). From 1 January 2004, European nations will be requiring the use of Pb-free solder alloys in all electronic assemblies. In Japan, similar legislation are proposed that by 2006 government will prohibit lead from being sent to land fills and other waste disposal sites.

In response to the lead-free soldering issue on the impact on environment, massive research efforts worldwide have been carried out to identify the suitable substitute. The work targeted at the development of direct substitute for 63Sn/37Pb for electronic manufacturing.

This invention is the result of an active research programme by IHPC's Computational Chemistry group, who focus mainly on computer aided materials research, chemical analysis and process simulation. The two inventors Dr. WU Ping (Division Manager) and Dr. Bai KeWu from the Computational Chemistry group is involved in applying computational model and simulation to discover new lead-free alloy composition that can be suitable substitutes for the Sn-Pb solder.

This is a new formulation for lead-free solder based on quaternary Sb-Zn-Mg-Cu to replace the environmentally unfriendly lead (Pb). It is an improvement from IHPC's Patent Application in Singapore (No. 200201728-3) by the same inventors, which describes a ternary lead-free alloy composing of Sn-Ag-Mg which manages to achieve an eutectic temperature of under 200OC. Recent experiments have confirmed that the eutectic temperature of the ternary ally has been met and can thus be a readily substitute for conventional 60Sn-37Pb solder. However, the ternary alloy is susceptible to oxidation and unexpected poor adhesion characteristic due to the presence of Mg. Thus lead to the extension to develop the quaternary alloy.

Thus, it is likely that with the successful prove of concept (productisation) of the quaternary lead free solder, it will enormously enhance the market attractiveness and improve the take up by solder manufacturer in terms of licenses for the IHPC quaternary lead-free solder technology.

The Institute of Materials Research and Engineering (IMRE)
Fuidlens

IMRE has developed a Fuidlens that uses drops of liquid as optical lenses and performs a dynamic adjustment of the focal length and magnification by balancing the lens surface tension and the liquid drop pressure in a controlled manner using an actuator integrated into the micro lens package.

When a voltage is applied to the actuator, the Fluidlens is formed and its curvature varied as function of the voltage applied and with it, the focal length. The Fluidlenses curvature can be switched in time scale of milliseconds from being convergent (Fig 1a) to divergent (Fig 1b). Zooms lenses without moving parts (Fig 1c) are fabricated by combining two or more liquid lenses. The capability of these zoom lenses to focus at short distances is shown in figure 2.

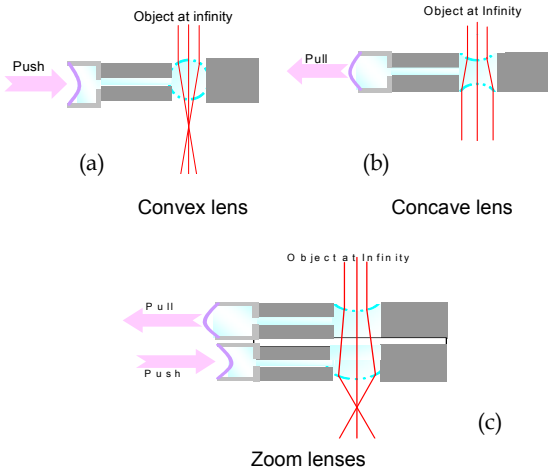


Figure1. Schematic of the Fluidlens device and operation

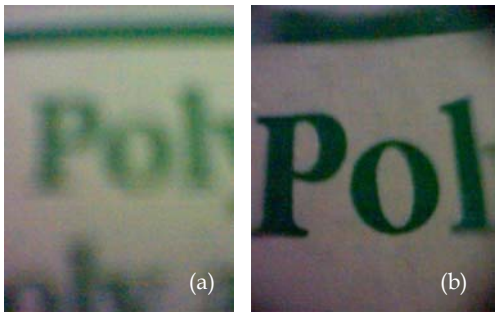


Figure 2. (a) Image from a conventional camera phone at a distance of 10 cm. (b)Zooming capability of a combination of 2 mm diameter Fluidlens and a fixed camera lens .