

# ILLUMINATE

## LUX unveils next phase plans at Q2 Members' Meeting

The LUX 2<sup>nd</sup> Quarter Members' Meeting of 2022 on 8 June saw LUX Chairman Prof Tjin Swee Chuan share that LUX will be focusing on its next phase plans, which will help drive efforts to translate IP into product realisation. In line with Singapore's interest in Lasers & Optics R&D for precision engineering, LUX has organised a series of focus workgroup meetings and the Singapore Photonics Workshop which identified three key topics of interests; namely, Flat Optics; Imaging Systems, Metrology & Sensors; Lasers and Fiber Optics.

For the next phase, LUX will focus on 3 key functions:

- Provide centralised photonics funding (e.g. for IP prototyping and productization, translation support) under a LUX seed grant
- Serve as a collaboration platform to facilitate research/industry partnership, etc
- Coordinate with Partners to strengthen technical/engineering support for IP productization



The meeting, held at the Nanyang Executive Centre Auditorium, was attended by 81 attendees from 37 LUX member companies as well as NTU, NUS and SUTD. LUX welcomed 18 new members (13 Industry and 5 Faculty) at the session.



Following Prof Tjin's welcome address and updates, program director Dr Soo Choi Pheng took over to promote key upcoming 2022 events: the LUX 3rd Quarter Members' Meeting on 28 September; the Industry Transformation Asia-Pacific (ITAP) 2022 from 18 to 20 October, where LUX will have a pavilion; the annual Photonics@SG conference on 8 November; and the International Delegates visit to Singapore which will tentatively be held from 9 to 11 November.

She also congratulated NTU's Assoc Prof Luo Yu and his industry collaborator, Meridian Innovation, for being awarded the LUX Seed Grant 9th Call and called for submissions for the next Seed Grant Call.

There were presentations by five new LUX member companies too.

**SIMTRUM** **理创科技**, which seeks to become the premier spectroscopy & microscopy E-commerce platform in Asia, introduced its product portfolio that includes spectrometer, integrating sphere, and Large NA High Sensitivity Spectrometer for Raman, Portable Raman System.



**AGC** **AGC Group**, which has businesses in over 30 countries, gave an overview of its business lines (glass, electronics, chemicals and ceramics) and discussed its photonics components for applications including 3D Sensing Module, Automotive and AR MR Glasses.



**LINX** **LINX**, a leading Machine Vision (the use of imaging-based technology and methods to provide inspection and analysis) distributor with its Southeast Asia headquarters in Singapore, shared its various applications ranging from general manufacturing, food & packaging, to electronics, and X-ray testing.



## Message from the Chairman/Co-director:

2022 has flown by quickly, and as we enter the second half of the year, it is important to assess how we can navigate the continued success of Singapore's photonics scene.

I recently shared, during our LUX 2nd Quarter Members' Meeting of 2022, about how LUX will be moving our focus to our next phase plans, which is to help drive efforts to translate IP into product realisation.

This is aligned to LUX's vision: To serve as a catalyst and a networking platform to translate cutting-edge research in photonics into diverse applications underpinned by the value chain created.

We are pleased to welcome 18 new LUX members (13 Industry and 5 Faculty) at the session, and doubly pleased to award the LUX Seed Grant 9th Call to Assoc Prof Luo Yu and Meridian Innovation. Congratulations, and I am looking forward to seeing the positive outcome of your collaboration!

In April, we also held the LUX- Enterprise Singapore Workshop on "Co-packaged Photonics/ASIC & Heterogeneous Integration". This is part of a series of workshops, organised in partnership with Enterprise Singapore, which seeks to bring together members of academia, SMEs and MNCs in the same space to share their challenges, and the capabilities, solutions and new innovations. I was pleased to receive feedback that the workshop is informative, well-organised and relevant.

We have many activities lined up for you for the second half of 2022, including the LUX 3rd Quarter Members' Meeting on 28 September; the Industry Transformation Asia-Pacific (ITAP) 2022 from 18 to 20 October, where LUX will participate; the annual Photonics@SG conference on 8 November; and the International Delegates visit to Singapore (tentatively, 9 to 11 November).

Together, we shine brighter – I know I can count on all of you as we move into the second half of 2022 and our next phase plans.

Prof Tjin Swee Chuan  
Chairman, LUX Photonics Consortium  
Co-Director, The Photonics Institute



The Photonics Institute

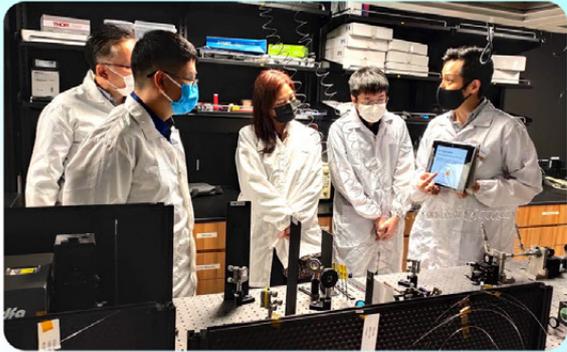




**Aerotech**, which has over 50 years' experience in motion and positioning products, presented on how it can partner with customers to help develop the automation around their photonics testing and assembly process. It provides Wafer Process and Photonic Assembly solutions too.



**Sunyu**, a joint venture with EHVA Inc (a spin-off company from the Centre for Optics, Photonics and Lasers [COPL], a world-class photonics research centre in Quebec City) discussed its turn-key test automation solution for production-scale photonic integrated circuits testing.



The LUX 2nd Quarter Members' Meeting also saw various lab tours conducted. Centre for OptoElectronics and Biophotonics (COEB) Director, Assoc Prof Steve Cuong Dang, hosted a tour to his centre and provided a demo on multispectral imaging and optical encryption. At the Centre for Optical Fibre Technology (COFT), Assoc Prof Wei Lei's team showcased their 8.5m dual-side fibre drawing tower, while Nanyang Asst Prof Chang Wonkeun demonstrated the ultrafast laser systems at LUCI (Laboratory for Ultrafast and Coherent Interactions).

At GREAT (Germanium Research and Technology), Prof Tan Chuan Seng's researchers demonstrated the photodiode measurement system and waveguide measurement and beam profiling. Finally, at the Centre for Disruptive Photonic Technologies (CDPT), Assoc Prof Cesare Soci's researchers provided a tour of the superconducting film fabrication and nanophotonics labs.

## Tech Talk Highlights

### Mid-Infrared Photonics for Gas Sensing and Spectroscopy Prof Wang Qijie, NTU

Prof Wang discussed the advantages of Quantum Cascade Lasers (compact size, low power consumption, tuning speed, direct modulation speed, highly selective and sensitive) and Broadband Mid-IR 2D photodetectors (compact, high-temperature operation, and low operation power) and their applications in sensing. He shared that due to their size, stability, and low power consumption, QCLs are ideal for unmanned aerial vehicle environments. They can also be used for liquid and solid sensing.



### Towards A Colour Pixel Design For Reflective Displays Assoc Prof Joel Yang, SUTD

Assoc Prof Yang suggested that reflective colour displays could be more energy-efficient, provide better colour gamut, and are more comfortable for the eyes. He explored new materials (phase change materials, electrochemistry) for faster switching, new methods (plasmonic and dielectric resonators) for colour generation, and new pixel architecture (hue and transmittance control) for full colour gamut.



### Geometric Photodetectors for Mid-Infrared Spin Light Assoc Prof Qiu Chengwei, NUS

Assoc Prof Qiu discussed his group's geometry-empowered recipe – employing plasmonic nanostructures array with judiciously designed symmetry, assisted by graphene ribbons to electrically read near-field optical information – for infrared photodetectors. This provides a robust, direct, strict, and high-quality solution to on-chip filterless circularly polarized light (CPL) detection, offering new opportunities for integrated functional optoelectronic devices.



### Superconducting Single Photon Detectors for Quantum Photonics Assoc Prof Cesare Soci, NTU

Assoc Prof Cesare discussed how, for detector engineering, his team is looking at the superconducting film deposition (NbTiN, MoSi, Wsi, MgB2...), design and nanofabrication of superconducting single photon detector chips, and demonstrator development: readout electronics, packaging, fibre-coupled cryostat. The team is seeking to optimize efficiency and extend operational range into the mid-infrared, integrate Superconducting Nanowire Single Photon Detectors (SNSPDs) with waveguides and nanophotonic structures, and studying detection schemes based on coherent perfect absorption.



# LUX - Enterprise Singapore Workshop fosters collaboration between SMEs, MNCs and faculty

The LUX- Enterprise Singapore Workshop on “Co-packaged Photonics/ASIC & Heterogeneous Integration” on 5 April successfully brought together SMEs, MNCs and members of academia in this space to foster technology development and collaboration opportunities.



Prof Tjin Swee Chuan



Mr Gaius Lim

LUX Chairman Prof Tjin Swee Chuan and Mr Gaius Lim, Deputy Director of Advanced Manufacturing at Enterprise Singapore, opened the event. The session at the NTU Innovation Centre Theatre was attended by 40, with 25 companies represented, and there were brief introductions from each of the companies.

## Companies participating in the workshop discussion



## Workshop Programme

Heterogeneous Packaging Advancements for Quantum Computing and 6G Wireless Applications by Palomar Technologies

Hybrid Si Laser for Co-packaging Optics by CompoundTek

Photonics Testing and Micro Assembly Automation Using Mechatronic Technology by Axis-Tec

Co-Packaged Optics: Challenges and Opportunities by Rain Tree Photonics

Free-standing Ultrathin Semiconductors for Flexible Optoelectronics by Asst Prof Kim Mumho, NTU

Wafer level Packaging at AMF by AMF

AMF's Chief Technology Officer Dr Patrick Lo said that silicon photonics with its integration, form factor and cost holds the key to eventual adoption of Co-Packaged Optics (CPO). He introduced AMF silicon photonics advanced packaging capabilities and the company's path to CPO.



Mr Dave Low, General Manager of Axis-Tec, shared the company's Design For Manufacturing services in the area of photonics testing automation and micro-assembly, using mechatronic technology, for mass production setup.



CompoundTek's Dr Lee Chee Wei discussed his company's work in hybrid III-V/silicon lasers, which have demonstrated performance metrics that would be difficult to achieve amongst solitary III-V lasers. The senior product manager added that hybrid III-V/silicon lasers will be relevant as the industry seeks to move from pluggable modules to CPO.



Mr Rich Hueners, Vice President of Palomar Technologies, spoke on "Heterogenous Packaging advancements for Quantum computing and 6G wireless applications", in particular, exploring the packaging of a laser whose wavelength is outside of the existing datacom wavelengths (~1500nm) using plasma activated bonding of IIIV material bonding directly to a SiN wafer.



Rain Tree Photonics' Co-Founder Dr Jason Liow discussed how CPO is needed to meet the power and bandwidth requirements for next-generation computing, and the challenges and opportunities with CPO.



In his talk, Asst Prof Kim introduced freestanding single crystalline semiconductors as an enabling material platform for flexible optoelectronics, and shared that applications include flexible ultraviolet, visible, and near-infrared photodetectors and electronic eye systems.



The workshop was positively received, with attendees saying it was "informative and relevant", "very well organized and good networking event", amongst other feedback.

# Growth Crystallized Tuned Optical Coupler for Sensors and Optical Networks

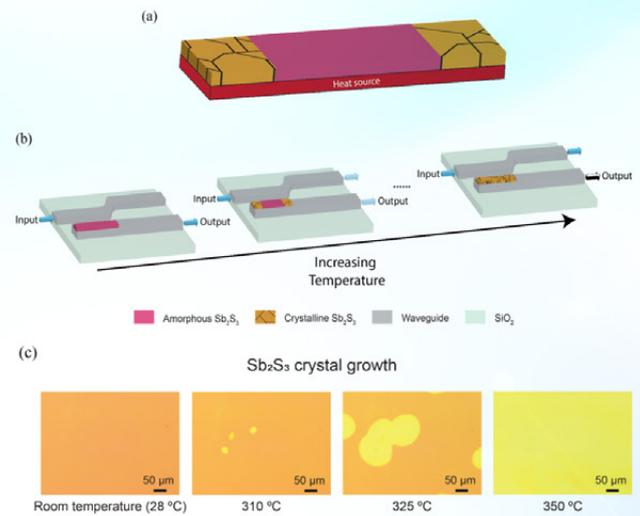
The Growth Crystallized Tuned Optical Coupler incorporates phase change materials (PCMs) that exhibit growth-driven crystallization into conventional optical coupler devices to tune their coupling ratio. Assoc Prof Robert Simpson and his team at Singapore University of Technology and Design (SUTD) coined this method Growth Crystallization Tuning (GCT) of optical couplers. The growth of the crystals is controlled by temperature. When strips of phase change material are deposited on the optical coupler device, it is being "baked" to set and program the coupling ratio. This tuned optical coupler can be applied in a wide range of optical network systems for instance, optical routers in server centres and optical neural networks. It has the benefits of highly reliable multi-level switching states, substantial energy saving i.e. only use energy during state programming and small footprint.

The GCT optical couplers have the advantages over other commonly known reconfigurable PCM photonic devices in that amorphous  $Sb_2S_3$  PCM exhibits growth-driven crystallization instead of nucleation-driven crystallization to achieve their tuning functionality. This allows for better control of the extent of crystallization of the PCM-tuned coupler devices i.e. the extent of crystallization can be mapped to the corresponding annealing temperature. Thus, multi-level bits can be achieved more reliably.

State-of-the-art tunable directional couplers make use of thermo-optic or electro-optic effects to tune the refractive index. This requires a continuous power supply to maintain the temperature and concomitant optical states. Therefore, the power requirement limits scalability in large-scale networks when the couplers are cascaded. In contrast, the GCT optical couplers are non-volatile and only use energy during the programming step. After the couplers are programmed, energy is not required to maintain the programmed state, and this represents substantial energy savings.

Commercialized tunable optical fiber couplers vary the gap between mated fibers to achieve reconfigurability and it requires more footprint to accommodate the shifting of the fibers. The GCT optical coupler has a reduced footprint as tunability is achieved by heating the deposited PCM on the waveguide. It can be easily tuned by annealing to a specific temperature. Due to the non-volatility nature of the material, it is robust and resistant to mechanical disturbances as compared to mechanical tuned devices which are bulky and unsuitable for integration into photonics on chip schemes.

Potential applications of GCT optical couplers include optical sensors or interferometers, on chip tuneable directional coupler for PICs, optical fibre coupler/splitter/multiplexer for optical neural networks and optical communication systems.



Optical coupler devices with phase change materials deposited is able to tune the coupling ratio by controlling the temperature.

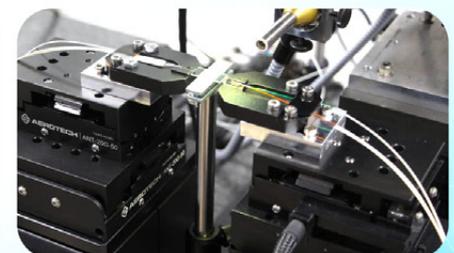
## New Industry Members Introduction

**AEROTECH** Since 1970, Aerotech Inc. has been the global industry leader in precision motion control and automation. From standard positioning technologies and control systems to custom-designed automation systems, our products support research and industrial organizations worldwide.

Aerotech precision motion control and advanced mechatronics provide micro- and nano-level accuracy to meet the tightest tolerances found in today's optics and photonics industry. With Aerotech as your partner, motion will never be a limiting factor in your operations. We can help implement your industrial automation tasks with the highest precision.

For Photonic Integrated Circuits (PiC), Silicon Integrated Photonics (SiPh) and micro-optics, we're the performance leader in the automation of test, inspection, alignment, assembly and packaging applications.

Photonics applications are increasing in many sectors. Optical inspection equipment and automated alignment systems are important for light source technology and measurement technology in the medical field, for example. You can reduce your implementation risk by partnering with an expert like Aerotech for photonics alignment and more.



Located around the world, Aerotech's electromechanical systems and motion control experts support your team, from design to delivery to daily production and optical inspection. You'll get the help you need for industrial automation when and where you need it.

## LINX

LINX Japan is the biggest Machine Vision distributor in Japan with an extensive 27 years of experience in the distribution business; brings cutting edge technologies and excellent products to the demanding Japanese market from all over the world. Armed with a global vision, the LINX group ventures out of Japan to create the same success by bringing great technology and expertise to customers in Asia. LINX Singapore was setup to be the Southeast Asian subsidiary under the LINX group, led by a Machine Vision veteran of more than 15 years.

Over the years LINX Group has evolved, and continuingly growing with our clients and in the ever-changing market.

LINX Singapore adopts an intrepid approach to take hold of opportunities in the exciting growth of the semiconductor, robotisation, Artificial Intelligence (AI) and Internet Of Things (IOT) industries. The organisation continues to stay true to our promise and strengths in distributing the best

and world-class products from various partners worldwide. As an expert and industry-leader in the distribution of the world's most advanced machine vision and automation products, we are fully committed to establish mutual, complementary and valuable partnerships.

For more information, visit [www.linx-sg.com](http://www.linx-sg.com)!



**LITEON**® Founded in 1975, and being the first listed electronics company in Taiwan, LITEON Technology is a world-leading provider of opto-semiconductor, power supply management and key electronic products with global manufacturing facilities. In recent years, with its active deployment in the fields of cloud computing, automotive electronics, 5G, AIoT and optoelectronics, coupled with expansion of new business for smart life, LITEON continues to use its professionalism, rich industrial experience, flexible supply chain management with quick response and diverse worldwide operational centers, has become the best partner of global customers for creating value, innovation, and application of smart technology.

For over four decades, LITEON produces products that are used in a broad range of applications, such as cloud computing, automotive electronics, optoelectronics, computers, 5G & AIoT, information technology and consumer electronics while concentrating on establishing competitive advantages to maximize the returns from a diverse product portfolio to realize profitable growths through resource integration and management; LITEON's main business strategy focuses on increasing resource utilization, automation, production optimization, and streamlined processes for better productivity and efficiency; in the long-term, the focus is on realizing profitability, maintaining stable operations as well as enhancing the return of shareholders' equity to take root in the sustainable operation of a century-old enterprise.

### Leading Global Provider of Optoelectronic Components

Display Module  
Visible LEDs  
IR/UV LEDs  
Light sensor



## QRT

QRT is a semiconductor quality test company that is an essential pillar of the semiconductor ecosystem. Our main business is "reliability test" and "failure analysis" of all semiconductor and related electronic parts for vehicles, IoT, and electronic elements in biofields. In addition, we are constantly improving the quality of analysis and reliability evaluation with equipment developed and developed jointly and customized with customers.

The reliability testing services provided by QRT include environmental, lifetime, physical, and ESD. In addition, failure analysis is divided into non-destructive, destructive, FIB, material, and property analysis. Based on various test services, QRT has built a network with more than 1,500 customers, including leading semiconductor companies in Korea and abroad.

Our primary customers are divided into Fabless, Foundry, OSAT/Packaging, Global Maker, Automotive Parts Maker, Set Maker, Equipment Manufacturer, and PCB Manufacturer. Recently, QRT R&D team has developed the precise/cost-effective RF device reliability monitoring equipment and Soft error (Semiconductor failure/error by radiation) measurement equipment and studied TPA(Two-Photon Absorption). In addition, R&D is conducting continuous research and analysis on Silicon Photonics technology.

For more information, visit <http://en.qrtr.com/html/en/index.asp>



## Industry News



### Eureka Robotics now backed by US\$4.25 million of funds

LUX Industry member Eureka Robotics has successfully raised a Pre-Series A round of US\$4.25 million and will use the funds to accelerate the development of its core product, Eureka Controller, which enables system integrators and manufacturers to deploy high accuracy-high agility (HAHA) tasks in factories.

According to Eureka Robotics' Co-Founder, Assoc Prof Pham Quang Cuong, one of the controller's advantages is it requires no coding knowledge to use – system integrators can easily develop high-performance HAHA solutions via a graphical interface.

At present, most technologies are capable of only either HALA (high accuracy-low agility) or LAHA (low accuracy-high agility) tasks, whereas HAHA is necessary to fulfil many tasks in the high-precision manufacturing space (e.g. electronics and optics).

The University of Tokyo Edge Capital Partners (UTEC) – founded in 2004 and amongst Asia's largest deep-tech investment firms today – led the Pre-Series A round, which also saw participation from Vietnam's Touchstone Partners and Eureka's seed round investor ATEQ. The funds will also enable Eureka Robotics to expand its commercial reach to new markets such as Japan and Vietnam, where its investors are based, and existing ones (Singapore and China).



## Upcoming Events



### 3Q Members Meeting

Date: 28 Sep 2022  
Format: In-person event



### LUX Pavilion at Industry Transformation Asia-Pacific (ITAP) 2022

Date: 18 - 20 October 2022  
Venue: Singapore Expo

Special Booth rate for members  
Contact us to find out!



### Annual Conference - Photonics@SG 2022

Date: 8 November 2022 (Tuesday)  
Format: In-person event



### International Delegates Visit to Singapore

Date: 9 - 11 November 2022 (Tentative)