



## International Delegates Experience Singapore's Vibrant Photonics Scene

From 9 to 11 November, LUX hosted an International Delegation Visit, facilitating guests from the European Photonics Industry Consortium (EPIC) and Quebec's photonics cluster Optonique in exploring the local photonics landscape and meeting key players from industry and academia.

The visit took place after a pandemic-induced hiatus of two years and brought a total of nine companies and one university to our shores: DELO, Materion Balzers Optics, NTS Optel, Superlum, Suss MicroOptics, Toptica (from EPIC, led by Director General Carlos Lee); EHVA Photonics, Femtum, TeraXion, ÉTS Montréal (from Optonique, led by Project Manager Jean Christophe Gauthier).



Day 1 of the packed programme began with the delegates getting a glimpse of the Singapore government's support for local industries thru meetings with EDB and Enterprise Singapore at the Singapore Business Federation.

The venue was sponsored by the Québec Government Office in Singapore, which seeks to identify business opportunities and partnerships for Québec organisations, such as Optonique, that want to position themselves in Singapore and Southeast Asia. They were represented by Chief Representative Rene Sylvestre; Director of Economic Affairs, Guillermo Moyano; and Commercial Attache, Kevin Ng.

In his welcome address, LUX Chairman Prof Tjin Swee Chuan (right photo) discussed Singapore's industry landscape for precision engineering (PE) and applications, its interest in photonics for PE with seven key growth areas (lasers & optics, sensors, advanced materials, semiconductor equipment, test & measure, additive manufacturing, and robotics), and introduced LUX and its mission, initiatives and programmes.



The delegation at the Singapore Business Federation.

There were also presentations by EDB, which provided an introduction to the organization, Singapore and our lasers & optics industry, and Enterprise Singapore, which discussed how it partners Singapore enterprises and its role in the Singapore startup ecosystem.

## Message from the Chairman/Co-director:

As we welcome 2023, I hope that 2022 has been a year of positives for you, as it was for us at the LUX Photonics Consortium.

With the improving Covid-19 situation, we were able to hold several well-attended events, meet our members in person again, as well as host overseas guests. We also continued to grow our LUX family, with 2022 additions taking us to 76 Industry and 69 Faculty members.

One of the final events for the year was Photonics@SG 2022, themed "Advances in Integrated Photonics", which LUX organised in partnership with NTU, NUS, SUTD and A\*STAR. Held on 10 November, the conference attracted a total of 170 participants, with 74 from Institutes of Higher Learning, Research Centres and Academia. There was also representation from 48 industry companies. I'm pleased to share that we received lots of positive feedback overall on the event.

In conjunction with the conference, LUX organised an International Delegation Visit on 9-11 November, where we hosted delegations from the European Photonics Industry Consortium (EPIC) and Quebec's photonics cluster, Optonique.

It was great to see our overseas friends again after the pandemic put travel plans on pause. I'm sure our EPIC and Optonique guests had a fruitful time learning more about our local photonics landscape and exploring opportunities for collaboration.

You can read more about these events and other exciting developments in this issue of Illuminate.

Last but not least, let me take this opportunity to wish everyone a Happy New Year!

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



The Photonics Institute





This was followed by visits to four LUX Industry members (below photos) – LightHaus Photonics, Moveon Technologies, Quantum Chemical Technologies and Phaos Technology – with the delegates hosted by management: Dr Phua Poh Boon, CTO & Founder; Dr Andy Low, COO (LightHaus); Chee Teck Lee, CEO; Sampath Kumar, Quality Director (Moveon); Vincent Kho, Managing Director; Chew Kai Hwa, R&D Director; Kho Ruizhou, Project Manager (Quantum); and Andrew Yeo, CEO; Tay Beng Boon, COO (Phaos).



Delegates were then ferried to the National Gallery where they were treated to welcome drinks at Smoke & Mirrors, and dinner at Yan Restaurant.

Day 2 was spent at the Photonics@SG 2022 conference, held at NTU's Nanyang Executive Centre Auditorium, with each company in the delegation given a three-minute slot to introduce themselves.

The International Delegation visit concluded on 11 November, with the delegates participating in B2B meetings pre-arranged by LUX.



There were plenty of networking opportunities at the welcome reception at Smoke & Mirrors... and an opportunity to admire the iconic Singapore skyline too!

The trip was certainly a productive one, with ample networking opportunities that allowed the EPIC and Optonique delegates and LUX member companies to showcase their technological capabilities, exchange ideas and explore opportunities for collaboration.

EPIC Director General Carlos Lee thanked LUX for being very welcoming to EPIC and its members, saying: "You have organized a very efficient delegation trip to help us understand and experience photonics in Singapore."

Added Natalie Tuchapsky of Superlum: "Thank you so much for organising such an amazing event for us!"

## Integrated Photonics in Focus at Photonics@SG 2022

Themed "Advances in Integrated Photonics", the Photonics@SG 2022 conference sought to establish industry interest in integrated photonics technologies, emphasize the strong link between academia and industry, and identify strong collaborative academic / industry teams for industry-aligned funding opportunities.

And with 170 attendees, including 74 from Institutes of Higher Learning, Research Centres and Academia (NTU, NUS, SUTD, SIT, and A\*STAR), and 48 industry companies represented, the event definitely achieved its goals.

With an Industry Delegation in town for the event, Photonics@SG 2022 also served to highlight Singapore's R&D efforts, and particularly in Photonics, to an international audience. The Industry Delegation comprised 15 companies, including some with the European Photonics Industry Consortium (EPIC) and Quebec's photonics cluster, Optonique. Each company was given a three-minute slot to introduce themselves.

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Thank you to the sponsors of Photonics@SG 2022!

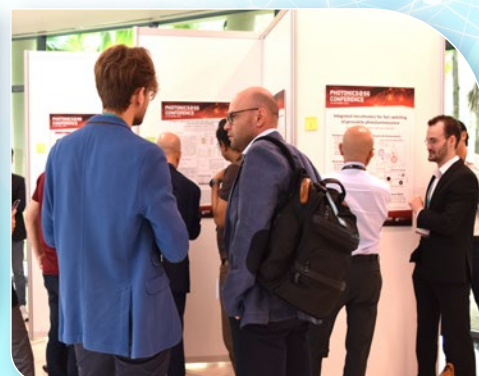


The 10 November conference, held at NTU's Nanyang Executive Centre Auditorium, had a packed agenda with eight speakers from academia (see separate box) and two from industry – EPIC's Director General Carlos Lee ("PIC in Europe from a Global Commercial Market Perspective") and Single Quantum's Chief Scientific Officer Val Zwiller ("Generation, Manipulation and Detection of Light at the Single Photon Level").



LUX Chairman Prof Tjin Swee Chuan (left) and Photonics@SG 2022 Conference Chair Assoc Prof Steve Cuong Dang of NTU deliver the Welcome and Closing Address respectively.

There was also a Research Poster presentation, with Best Poster awards handed out to Anton Vetlugin of NTU – "Non-local Quantum Metrology using Geometric Phase" (1st prize), Teo Ting Yu of SUTD – "Designing Chalcogenide Reconfigurable Integrated Photonics for All-optical Neural Networks" (2nd prize), and Abhishek Kumar of NTU – "Terahertz Topological Photonic Integrated Circuits for 6G communication".



A packed Nanyang Executive Centre Auditorium – the conference attracted 170 attendees, with plenty of time for networking during breaks.

The day's programme concluded with a Conference Networking Dinner at the Concorde Hotel.

## An overview of the Academic presentations:



### Advances in Entangled Photon Generation, and Next Steps

Assoc Prof Alexander Ling,

Principal Investigator, Centre for Quantum Technologies and Dept of Physics, NUS (Plenary Speaker)

Assoc Prof Ling discussed how entanglement is a critical resource in quantum technologies. With the engineering of pairs of photons sharing strong correlations now relatively mature, he asked if we should apply this technology to chip-scale devices and raised some challenges for the integrated photonics community to solve.

### Photonic Time Crystal

Prof Nikolay I. Zheludev,

Co-Director, The Photonics Institute; Director, Centre for Disruptive Photonic Technologies, NTU; Deputy Director, Optoelectronics Research Centre, University of Southampton, UK (Plenary Speaker)

Prof Zheludev shared that a classical metamaterial nanostructure – a two-dimensional array of plasmonic metamolecules located on flexible nanowires – can be optically driven to the state with all key features of continuous time crystal. This can be manipulated all-optically and has applications in frequency conversion, memory, modulation, nonreciprocity and amplification.







### Heterogeneous Integration of Surface Ion Trap, Silicon Photonics and 3D-TSV

Prof Tan Chuan Seng,  
School of Electrical & Electronic Engineering, NTU

Prof Tan discussed his team's work on surface ion trap (Sr+) with respect to its RF and ion-trapping performance (the choices of glass substrate, insertion of ground plane and 3D-TSV are included); design and performance of active and passive silicon photonic components; and a vision of future quantum computing systems that are both CMOS compatible and scalable.

### Bragg Soliton Dynamics on a Silicon Chip

Assoc Prof Dawn Tan,  
SUTD; A\*STAR Institute of Microelectronics

Assoc Prof Tan discussed bragg solitons – solitary waves which form as a result of the nonlinearity in the medium and the dispersion induced by a Bragg grating – as well as the demonstration of optical parametric Bragg amplification, low power picosecond pulse generation and high spectro-temporal compression on a chip.



### Development of Mid IR Nanophotonics Sensors

Assoc Prof Chengkuo Lee,  
GlobalFoundries Chair Professor, NUS

Assoc Prof Lee spoke about the advantages of nanophotonics (and / or metamaterials) enhanced features – high sensitivity, low limit of detection, low crosstalk, strong detection multiplexing capability, and small footprint – and that they pave the way to miniaturize the sensors and realize on-chip integration of various photonic components, so as to achieve chip-scale sensing systems for future 5G / Internet of Things (IoT) applications.



### Silicon THz Photonics Driven 6G @ 0.33 Tbps

Assoc Prof Ranjan Singh,  
School of Physical & Mathematical Sciences, NTU

Assoc Prof Singh said that silicon topological photonics would facilitate augmentation of CMOS-compatible hybrid electronic-photonics driven terahertz technologies, which are vital for 6G communication. He introduced a new class of on-chip silicon THz photonic devices consisting of low-loss, broadband single channel 327 Gbit/s communication link.



### Optical Metrology for Single Photon Detector

Dr Zhang Jing,  
National Metrology Centre, A\*STAR

Dr Zhang Jing shared that because cutting-edge applications in fields such as quantum information, optical computing, and quantum cryptography have demanding requirements on the accuracy of single-photon measurements, accurate characterization and calibration of single-photon detectors is vital for developing quantum photonics platforms.



### Halide Perovskite Metamaterials and Metadevices

Assoc Prof Cesare Soci,  
Deputy Director, Centre for Disruptive Photonic Technologies, NTU

Assoc Prof Soci discussed how the combination of high refractive index with unique structural phase-change, luminescence, and charge transport properties of halide perovskite films enable the realization of monolithic dielectric metamaterials and light-emitting metadevices with complex optical functionalities.





# New Industry Members Introduction



Materion Balzers Optics is a global leader in optical thin film coating solutions. We are the preferred partner for providing innovative optical coatings and solutions for over 70 years. From the UV through the Far IR, we custom manufacturer and supply precision optical filters and coatings. As a high-tech company with 5 production sites worldwide, our focus is on a variety of markets such as Life Science, Industry, Consumer, Lighting, Space, Defense and Automotive.

With a full range of unparalleled products, services, and support technologies, our customers benefit from our strategically located global facilities that provide regional manufacturing and technical support. Materion Balzers Optics superior quality products are fully supported by a large volume manufacturing environment that produces highly repeatable results, contributing to reduced costs and market advantage. We also have scalable processes that are economical for customers who require small quantities. Thanks to our technical expertise and access to broad resources throughout the Materion Group (NYSE: MTRN), we are uniquely positioned to offer solutions to our customer's most demanding challenges. Our offerings include Filter Arrays, DLC, Ultra-Narrow Bandpass, Linear Variable, High Reflector, Patterned Coatings, Wafer Level Coatings, and Getters, and many others.



Materion Balzers Optics is represented in Asia in Singapore, Malaysia, Taiwan, China, Japan and Korea with own production site in Shanghai and Penang.



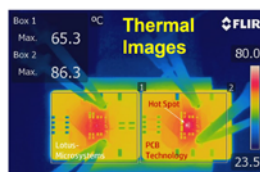
Lotus Microsystems makes the world's smallest power converters. Leveraging breakthrough research, technology and intellectual property, Lotus Microsystems is a fabless semiconductor manufacturer of highly efficient and super compact power management components. Our patented silicon-based integration technology allows us to build a substrate for a 3-dimensional structure that hosts power circuits, control circuits and passive components like inductors and capacitors in single miniaturized units. In addition, our power modules are built with materials that have superior thermal conductivity to deliver market-leading thermal performance and reliability in a super compact package. Such unprecedented miniaturization capabilities are in high demand for the development of future mobile phones, laptops, and medical devices where UX and technical development priorities dictate size reduction, increased battery life and new added features.

## Power Interposer Technology (PIT) for the World's **smallest** power converters

- ✓ High power density
- ✓ Superior thermal performance
- ✓ Scalability (design, size, specifications)
- ✓ Heterogeneous integration



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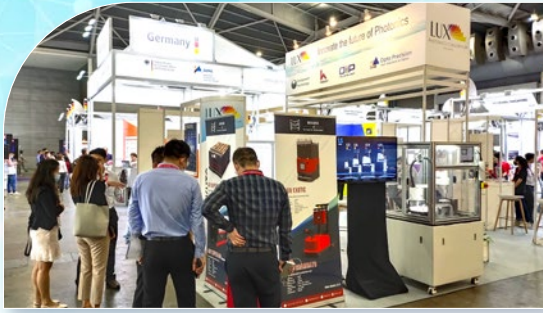
Technology Benchmarking



Wide range of Applications



# LUX Displays Photonics Tech For Industry 4.0 at ITAP 2022



Themed "Industry 4.0 for Business Sustainability", the 5th edition of Industrial Transformation Asia-Pacific (ITAP) attracted over 15,000 attendees, including many overseas exhibitors and visitors, and brought together manufacturers, technology providers and thought leaders to catalyse opportunities for innovation.

The fully in-person 18-20 October exhibition provided a ready audience for LUX and its member companies to demonstrate – under one roof at the LUX Pavilion comprising six booths – their collective photonics technologies (sensors, lasers, optics, optical metrology, photonics integration) as an enabler for industrial automation and applications.

As part of the LUX Pavilion at Hall 2, LUX members – Component Technology, Hakuto Singapore, OIP Technology and Opto Precision – also enjoyed a lower-cost booth versus a standard 12-sqm booth.



Component Technology showcased its innovative and tailored inspection solutions and AOI (Automated Optical Inspection) capabilities.



Hakuto exhibited its automation solutions, the Mokara AGV (Automated Guided Vehicle) and held a robotic pick and place demonstration with the Epson robot.



OIP Tech promoted its advanced optical packaging technology for optical sensors and silicon photonics module.



Opto Precision showed its AR / VR / MR solutions and optical components for industrial automation.

## Upcoming Event

**2023 1st Qtr  
Members' Meeting**

**Date: 1 March 2023**

**Venue: NTU Innovation Centre (TBC)**

**Mark your  
Calendar!**

