ILLUMINATE

Nov/Dec 2016 • ISSUE #03

Sparks fly when academia and industry meet at LUX

Members from academia and industry were brought together at the LUX Photonics Consortium Members' Networking Event on 26th August.

Chairman Prof Tjin Swee Chuan kick-started the event, held at NTU's 108-seat Theatre@The Nest, by sharing his master-plan for the Consortium.

Fittingly, after he spoke on expanding its network, LUX's newest industry members – GLOBALFOUNDRIES, Tip Biosystems, d'Optron and LightHaus Photonics – were introduced to a group of over 70 including other industry members, faculty members as well as invited guests from the likes of the National Research Foundation (NRF), Economic Development Board, International Enterprise Singapore, and Nanyang Technological Univeristy - NTUitive Pte Ltd. GLOBALFOUNDRIES, Tip Biosystems and d'Optron representatives were also present to share more about their respective companies.

Said Tip Biosystems representative Rene Joseph: "The Lux Consortium is a one-of-its-kind initiative in Singapore, and probably even within the region, which brings people from industry and academia together in one platform."

"We hope to benefit from the technical as well as the networking events organized by LUX. We also see it as a platform to connect with the right technology and research partners within Singapore and the region."

Indeed, industry members like Rene got to hear from 11 of the faculty members on their key research focus and potential areas for industry collaboration. These included the two newest Competitive Research Programme (CRP) projects led by Assoc Prof Lee Chengkuo and Asst Prof Yu Hao of NUS and NTU respectively.

The latter's work explores the use of complementary metal-oxide-semiconductor (CMOS) terahertz meta-devices in building high-speed links for data servers. Requiring lower cost and power as compared to existing data servers built on silicon photonics, they could revolutionise the worldwide US$13 billion server market.

Meanwhile, Assoc Prof Lee's research into using Aluminum Nitride (AlN) as the chief ingredient to create more affordable, smaller-scale nanosensors could have huge implications for the local photonics industry and optical chipmakers.

LUX Chairman Prof Tjin Swee Chuan shares his vision for the Consortium, as well as activities to promote the industry's interest in R&D and generate value for members.

(from right) Assoc Prof Zhou Guangya and Prof Hong Minghui, both of NUS, with LUX Programme Director Dr Soo Choi Pheng at the event registration.

Message from the Chairman/ Co-director:

This is our 3rd issue of ILLUMINATE. In this issue, we are delighted to introduce our newest industry members of LUX Photonics Consortium – d'Optron, GLOBALFOUNDRIES, Hillhouse Technology, LightHaus Photonics and Tip Biosystems which joined us during the last quarter. A networking event organised in August at NTU, brought together our members from academia and industry to mingle and spark ideas over food and beer. We will continue to act as a platform to connect technology and industry within Singapore and the region.

TPI and LUX have been actively expanding our network globally. Our presence at local events and exhibitions such as IP Week @ SG 2016 and SPETA outreach event helps us to reach out to different industrial markets in Singapore. In September, TPI sent a delegation of professors to visit Yonsei University in Seoul, South Korea and generated collaborative projects between the two universities. After the European Photonics Industry Consortium (EPIC) AGM meeting and MoU signing at Zurich in April this year, we had a visit to Singapore by ficonTEC, a Germany based company seeking to establish a presence in Asia. This interest is a result of a talk that I delivered during the EPIC AGM, offering Singapore as a possible gateway to a vast Asia market. In addition, EPIC is planning a delegation of CEOs to Singapore which will likely happen in January 2017. We will arrange company visits and networking sessions with LUX members, and hope that through these, business and research partnerships can be formed.

Lastly, I take this opportunity to extend my holiday greetings to all TPI and LUX members, wishing you and your loved ones a joyous and blessed Christmas and a Happy New Year.

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

TPI
THE PHOTONICS INSTITUTE
SINGAPORE

LUX
PHOTONICS CONSORTIUM
SINGAPORE

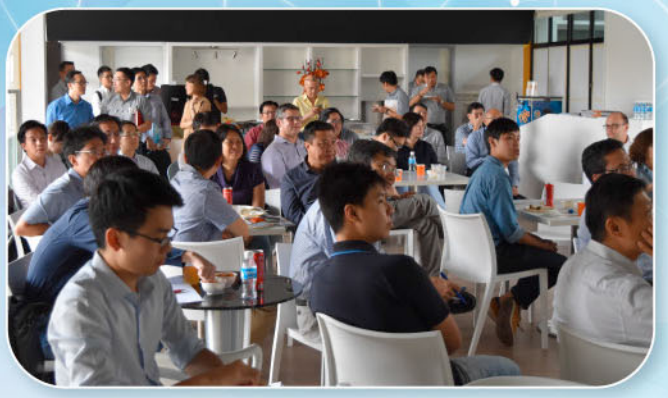
An initiative of both Nanyang Technological University (NTU) and National University of Singapore (NUS), supported by National Research Foundation (NRF), Singapore.

NRF Program Director, George Loh, speaking to all members of LUX.

The second half of the event saw the guests adjourn to the site of NTU's former PitchStop Café to mingle and network over finger food and beer. There, George Loh, program director at the NRF, Prime Minister's Office, spoke on the Research, Innovation and Enterprise 2020 Plan and the Singapore government's commitment to it, including setting aside $19 billion, or about 1 per cent of the nation's GDP, for this purpose.

He also talked about the need to build on the significant investments made in photonics R&D – such as the $75 million invested in LUX's first nine CRPs – and create value through technology consortia with industry.

The start-ups and SMEs present gleaned useful knowledge too as Spring Singapore explained how they can grow their businesses through the Technology Enterprise Commercialisation Scheme and Capability Development Grant respectively, while NUS Enterprise shared its Lean Launchpad that can validate the commercial viability of a company's technology.



The cosy setting of NTU's former PitchStop Café provided the fertile ground for an exchange of ideas between guests from industry, academia and government.

Meet LUX's newest industry members...

d'Optron's novel optronics systems enable quantitative 4D imaging over a wide range of applications including microelectronics, biomedicine and precision engineering.

One of the largest foundries in the world, and with operations in Singapore, Germany and the United States, GLOBALFOUNDRIES serves over 250 customers worldwide.

With its CeleX high-speed dynamic vision sensors, the smart cameras developed by Hillhouse Technology are able to perform real-time analysis of high-speed motions.

LightHaus Photonics is a Singapore start-up focusing on the development of advanced photonics/optronics imaging systems.

Tip Biosystems seeks to revolutionise how liquid samples are analysed using photometry in laboratories and industries.

Featured Research Capability

Imagining the future of photonics

For a research centre that looks ahead to the future – generating a knowledge base for new light-based technologies with a 10-plus year outlook – the Centre for Disruptive Photonic Technologies (CDPT) has already achieved more than modest success in the present.

It has put NTU on the global map of nanophotonics research institutions by organising large-scale events like *META'14*, the 5th International Conference on Metamaterials, Photonic Crystals and Plasmonics, which saw more than 700 attendees gathered at NTU, as well as more focused, topical workshops like the *Singapore-Japan workshop on Nanophotonics, Plasmonics and Metamaterials.*

And according to the Thomson Reuters-run Web of Science, since the opening of the CDPT in 2012, NTU has become the top worldwide institution in metamaterials research by publication number and the third by publication impact.

Says the CDPT's Deputy Director, Assoc Prof Cesare Soci: "With the engagement of Prof Nikolay Zheludev, a leading scientist in the fields of photonics and metamaterials, as our Director, the CDPT was set up to consolidate the numerous but then-disjointed research activities in optics, spectroscopy and photonics at NTU, and to become a hub for nanophotonics in Singapore and Southeast Asia."

But first, it was vital that the right infrastructure was in place to support a comprehensive research agenda. CDPT Phase 1 saw the installation of a cluster of state-of-the-art nanofabrication and optics laboratories in just a few months. CDPT Phase 2 was completed a year later, bringing with it a cluster of microwave, THz and infrared nanophotonics laboratories.

"Today, CDPT is a powerhouse for nanofabrication and optical characterisation, spanning an extremely vast range of spectral (from microwave to optical frequencies), time (down to a few femtoseconds), and space (down to a few nanometres domains," says Assoc Prof Soci.

He shares that the CDPT has also built up a large network of international collaborators and research centres – such as the University of Southampton's Optoelectronics Research Centre, which is famed for its expertise in fibre technology and understanding of photonics – to tap on. "We have a number of outstanding research collaborators from Europe, the United States and Asia, and they are actively working with and exchanging students and research staff with us on a regular basis."

In addition, the CDPT has invaluable partnerships with the likes of the Japan Society for the Promotion of Science and the European Cooperation in Science and Technology, the longest-running European framework supporting transnational cooperation among researchers, engineers and scholars across Europe.

Adds Assoc Prof Soci proudly: "Today, we number about 15 investigators, 10 project leaders and 20 PhD students from Europe, the United States, Asia, and, of course, Singapore. This has created a truly international, vibrant and productive research environment."

"We are also currently running about 15 research projects on various fundamental aspects of optical materials and metamaterials, as well as nanophotonics."

Assoc Prof Cesare Soci, Deputy Director of the Centre for Disruptive Photonic Technologies (CDPT).

Dr. Giorgio Adamo, Research Manager of the Centre for Disruptive Photonic Technologies (CDPT), operating the newly commissioned Time Resolved Cathodoluminescence Microscope.

Novel research and exciting technologies

Currently, the research being conducted at the CDPT encompasses three main areas: reconfigurable, dynamic and quantum metamaterials; reconfigurable micro/nano-fibres and cognitive photonic systems; and nanolasers, spasers and nano-metamaterials for electromagnetic technologies.

The centre's research may offer ground-breaking solutions for a variety of real-world applications – with a ten-plus year outlook – with the possibility of being employed in telecommunications, energy, light generation, imaging, lithography, data storage, sensing, medicine, security and defence.

Enthuses Assoc Prof Soci: "Some of the technologies we work on are quite exciting. One project deals with super-resolution lenses based on the phenomenon of superoscillations: by using adaptive algorithms to design specific nanostructures that focus light into "needles", we are able to increase the resolution of an optical imaging system – such as a microscope – beyond the fundamental diffraction limit." The resolution of optical microscopes is currently limited by the diffraction of visible light, so the CDPT's research could have huge implications for nanophysics, biotechnology, and pharmaceutical research – all fields that rely heavily on the optical microscope.

He mentions another research area called cognitive photonics, in which optical

networks made of optical fibres, silicon photonics or plasmonic waveguides are used to perform complex mathematical operations. "Think of the global Internet fibre-optic network as a brain, in which cognition and memory could emerge from the way fibres are connected together and signals are transmitted from one node to the others."

Assoc Prof Soci believes that the CDPT has benefited from being under The Photonics Institute's umbrella: "It has led to opportunities to apply jointly to competitive research funds like in the first Agency for Science, Technology and Research's (A*STAR) Advanced Optics in Engineering Programme."

"Then, we partnered with the Centre for Optical Fibre Technology, which is also under TPI, and successfully carried out two projects on specialty fibre-enabled super-resolution optical technologies and fibre nano-manufacturing."

CDPT'S new five-year plan

Assoc Prof Soci is excited about the potential in Singapore's photonics scene, enthusing: "In the last few years, we have seen an incredible expansion of photonics R&D here. This has created a fertile ground for spurring research from academic laboratories to industry. In addition, another significant development has been the launch of the LUX Photonics Consortium."

As for the CDPT, he reveals that its second phase is currently being mapped. "Photonics is one of the research strengths and focus areas in the NTU 2020 strategic plan."

"For this second phase, which will begin at the end of 2017 and will span the following five years, we have identified quantum and topological nanophotonics as the two areas of major interest – where CDPT is at the forefront of the international research scene, and in which we could make a large impact."

- Established by the first Tier 3 grant of the Singapore Ministry of Education
- More than 20 million dollars in competitive funding
- 45 Investigators, Researchers & PhDs
- 800 m^2 of research labs, cleanroom and offices
- More than 250 journal publications in the first 4 years
- More than 500 conference presentations, 30 Keynote and Plenary & more than 150 Invited talks
- More than 40 papers in the Nature Publishing Group Journals and Science

August augurs well for LUX

The week of 22nd August was a productive one for the LUX Photonics Consortium in terms of its outreach efforts.

It took part in two events in four days: exhibiting at the Intellectual Property (IP) Ecosystem Fair from 22nd to 24th August, and then presenting at the SPETA Outreach Event organised by SPRING Singapore and Singapore Precision Engineering and Technology Association (SPETA) on 25th August.

The IP Ecosystem Fair, part of the IP Week @ SG, saw the likes of IP law firms, management and business consultancy firms, as well as technology and data service providers exhibit alongside tertiary institutions and innovation clusters. LUX was running an exhibition with its partner NUS Enterprise and its Chairman, Prof Tjin Swee Chuan spoke on the topic of "IP Pooling Model: Photonics".

Said Prof Tjin of the event which was open to the public and attracted entrepreneurs, innovators, venture capitalists and IP professionals: "We were able to share our IP model with a larger community, and how industry members can easily partner and work with Institutes of Higher Learning to evaluate non-exclusive IPs for free for up to three years, and adopt it for commercialisation later where appropriate."

"We made many business contacts and achieved good publicity for the Consortium. A few companies approached us and were interested to find out more – we took the opportunity to invite them to our networking event held the same week to observe the proceedings with a view to joining the Consortium."

LUX Programme Director Dr Soo Choi Pheng was equally pleased with the outcome of the Consortium's participation in the SPETA Outreach Event at e2i, Devan Nair Institute. She spoke on LUX's aim to provide local enterprises with access to photonics research expertise and facilities.

As shared by the advisor of SPETA, Mr. Steven Koh: "SPETA has over 200 members and one of its key missions is to help its Precision Engineering member companies transform via innovation, integration and internationalization, as well as redirect them to higher value and growth areas like medtech, optics and photonics, and the Internet of Things."

"LUX can serve as the research platform for SPETA and its members to innovate their products and services."

LUX Chairman Prof Tjin Swee Chuan spoke on the "Intellectual Property (IP) Pooling Model: Photonics" at the IP Ecosystem Fair, part of the IP Week @ SG.

SPETA advisor Mr Steven Koh spoke at the outreach event held at e2i, Devan Nair Institute.

LUX Programme Director Dr Soo Choi Pheng shared how the Consortium can serve as the research platform for SPETA and its members to innovate their products and services.

Checking out European Photonics Industry and Start-up scenes

LUX Photonics Consortium always keep look out for innovative photonics technology to stay relevant and benchmark the best in photonics research and applications. The micro photonics international congress and expo held in Berlin on 11-13th October 2016, is one such trade show that LUX attended, and also sponsored the European Photonics Start-up Challenge 2016 held in conjunction with the trade show.

Eight finalists pitch in their best for the top prize. These start-ups' ideas and products are both innovative and refreshing, with big potential commercial value and disruptive to the photonics industry. The winning team from Germany is one such example, *Sicoya* - a spin-off from Technical University of Berlin, develops fully-integrated silicon photonics transceiver chips designed for server interconnects in data centres. This is set to revolutionise the industry with their 100-Gbit/s transceiver chip featuring integrated electronics and optics on a single chip.

Another start-up *mirSense* from France is using quantum cascade laser (QCL) for their compact laser based gas sensors. The QCL-based sensor is as big as a palm only at current stage and can be used in applications like air quality and vehicle emission monitoring, biomedical and defense.

Lilian Labs from Germany is developing a water analysis device for everyone! The handheld water quality sensor works with a smartphone application software stack that collects various types of data and performs analytics in a snap and it is targeted at the fish-keeping mass market, swimming pools and even drinking water monitoring.

French start-up *Teratonics* developed terahertz(THz)-frequency sensing for non-destructive evaluation and testing in industrial environment. The non-ionizing and contactless technology can sense structural defects and other functional materials for quality assurance and control.

Crystalline Mirror Solutions from Austria manufactures low-noise reflective optics using proprietary coating technology. The novel AlGaAs coating has high thermal conductivity and its active electro-optic properties brings along potential application for high power laser systems.

EPIC member visited Singapore...

and Stay tuned for EPIC Delegates trip to Singapore, 11th ~13th January 2017

Engaging with European companies through the partnership with EPIC extends LUX's network with the industry. Most recently LUX hosted an EPIC member company *ficon*TEC's visit to Singapore for gaining a good insights to the business and R&D ecosystem. Partnership between LUX and EPIC becomes a very good platform for members of both consortiums to benefit from the values created through these business networking activities.

There are growing interests from both sides to form closer business link, and we are getting the first "EPIC/LUX Consortium Delegation to Singapore" in January 2017. More details will be communicated to members when we have firmed up all the logistics arrangement. Stay tuned!

Industry News

Pitch perfect

A startup team led by Prof Hong Minghui (an active Faculty member of LUX Photonics Consortium), was one of 10 start-up teams selected to pitch at the inaugural *Ventures Day* on 3rd and 4th October.

The event was organised by Applied Materials, Inc., a Fortune 300 company and the global leader in materials engineering solutions. Its venture capital arm Applied Ventures invests in early-stage technology companies that can advance or complement Applied Materials' core expertise.

Prof Hong, of the National University of Singapore (NUS), was also recently awarded the Institution of Engineers Singapore (IES) Prestigious Engineering Achievement Award, for his work in developing a Super-resolution and High-sensitivity Optical Nanoscope. Part of a Competitive Research Project funded by the National Research Foundation, the optical microsphere nanoscope technology developed by Prof Hong and his team can significantly increase the resolution of an ordinary optical microscope via an attachment device that fits most commercial microscope models.

A Class Above, a program by Channel News Asia

Technolite, one of the industry members of LUX Photonics Consortium, was selected to be featured in the Channel News Asia's program "A Class Above", which aims to promote local SME who is outstanding in its own field. The program takes a closer look at leading companies and showcases how their vision and services create distinctive strengths which have made them *a class above*. Indeed Technolite partners with NTU to leverage the research expertise for their R&D initiatives and garners the support of National Research Foundation (NRF) for their collaborative project with The Photonics Institute at NTU, which has been covered in Issue02 of *ILLUMINATE*.

Technolite is an architectural lighting specialist recognized for empowering designers with an extensive range of cutting edge luminaires from the world's best brands. Since its inception in 1991, it has grown to become a leader in the lighting industry today. For more information about Technolite, please visit the Company's website at www.technolite.global.

Local Conferences

Mega Conferences in 2017 – Photonics@SG 2017

LUX Photonics Consortium and The Photonics Institute are proud to be sponsors for Photonics@SG 2017.
This mega conference brings together international leading researchers, scientists and engineers who are actively working in lasers and their applications, nanophotonics, metamaterial, biophotonics, plasmonics, optical devices, optical transmission and optical networking, optical fibers, optical switching system and related technologies. The conference will combine the following three major international conferences, which widely covers in the field of "Photonics" from devices to systems and networks.

- The 12th Conference on Lasers and Electro-Optics Pacific Rim(CLEO-PR 2017)
- The 22nd OptoElectronics and Communications Conference (OECC 2017)
- The 5th Photonics Global Conference 2017 (PGC 2017)

Mark these important dates in your calendar!

Important Dates	
Abstract Submission Deadline	16 Jan 2017
Acceptance Notification	From 14 Feb 2017
Conference Registration Opens	14 Feb 2017
Fee at Discounted Rate Ends	19 Mar 2017
Conference Dates	31 July - 4 Aug 2017

Website:
http://www.photonics2017.org

Contact us for exhibition

Email:
LUX_Chairman@ntuitive.sg

MTA2017 Updates

THE 21ST EDITION mta MANUFACTURING TECHNOLOGY ASIA 2017

We are pleased to announce that eight consortium members have signed up to participate in MTA2017. They are **II-VI Singapore, D'Optron, EINST Technology, Finisar Singapore, Hillhouse Technology, Hylax Technology, LightHaus Photonics and Tip Biosystems.**

Optics & photonics INNOVATION HUB

Limited exhibition space is still available at an attractive rate of SGD600 (excluding GST) per pod.
Hurry! Contact us if you are interested, email to LUX_Chairman@ntuitive.sg
For more information, visit http://mta-asia.com/

TPI The Photonics Institute Singapore
LUX Photonics Consortium Singapore

d'Optron · EINST · FINISAR · HILLHOUSE · HYLAX TECHNOLOGY · II-VI INFRARED · LightHaus · Tip Biosystems