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# Photonics@SG conference provides bright finale to 2018

The Photonics@SG Annual Conference was started to bring together academia and industry from the optics and photonics scene in Singapore to explore novel ideas.

And the third edition on 26 November 2018 certainly achieved this, drawing a strong crowd of around 150 comprising researchers, academics, industry members and students.


*Prof Tjin Swee Chuan gave a welcome address to all participants at Photonics@SG 2019.*

The guest list also included luminaries such as Prof Din Ping Tsai (National Taiwan University), Prof Sir Peter Knight (Imperial College UK), Prof Ben Eggleton (University of Sydney) and Prof Satoshi Kawata (Osaka University), who inspired with thought-provoking plenary and keynote presentations.


*Guest-of-Honour, Prof Subodh Gautam Mhaisalkar, sharing with the audience that NTU has many on going collaborations with industry such as Rolls-Royce, ST Engineering etc.*

Organised by The Photonics Institute (TPI) and LUX Photonics Consortium, Photonics@SG 2018 focused on the theme of Materials for new Photonics Technologies and Applications. The one-day conference was held at the NTU School of Humanities and Social Sciences (HSS) Auditorium and covered a broad range of topics from metamaterials and plasmonics to fibres, lasers, Nanoelectromechanical systems (NEMS) and silicon photonics.

Prof Tjin Swee Chuan, TPI Co-Director and LUX Photonics Consortium Chairman opened the event, and Guest-of-Honour Prof Subodh Gautam Mhaisalkar, NTU's Associate Vice President (Strategy and Partnerships), addressed the guests too, before Prof Din Ping Tsai delivered the first plenary talk.

The Distinguished Professor at the Department of Physics, National Taiwan University, and Director of the Research Center for Applied Sciences, Academia Sinica, spoke on the topic of "Meta-device for Photonics in Demand".

Prof Tsai discussed metasurface and their ability to control the electromagnetic phase and amplitude at subwavelength scale, and shared that there is growing interest in the field of meta-devices, where we can attain novel optical functionalities through changing the features of metasurface.

He also spoke about metasurface-based components for photonics applications, including versatile polarisation control, pixel-scale metalens, and achromatic meta-lens for imaging and sensing.


*Prof Din Ping Tsai spoke on the topic of "Meta-device for Photonics in Demand".*

LUX Faculty members Assoc Prof Zhou Guangya of the National University of Singapore and Asst Prof Robert Simpson of the Singapore University of Technology and Design (SUTD) were amongst the Invited Academic Speakers.

# Message from the Chairman/Co-director:

It has been three years since we embarked on this journey of the LUX Photonics Consortium together with all our members. We meet up every quarter – seek to understand each other better and to get up-to-date with the latest technologies developed by researchers in Universities and Research Institutes. Closer collaborative relationship is forming. Cumulatively, 12 research collaboration projects had been facilitated between academia and industry in the area of photonics, and many more are in the pipeline.

Our effort has echoed well with the national interest to grow innovative economy, which is part of the message delivered in the recent Budget Speech by Minister of Finance, Mr Heng. In his speech, he mentioned about his visit to LUX Photonics Consortium, applauded the extra mile taken by two LUX members, Technolite and Nanoveu, in embracing new technologies (developed by NTU) that re-innovate each's business/product offering. We hope to see the fruits of such research collaboration realising into new innovative product in near future.

On 27th November last year, it was the first time for LUX Quarterly Networking session being held at a LUX member's premise. We are very grateful that our industry member, Palomar Technologies, co-host this networking session. At the event, all LUX members witnessed the opening of the new Palomar's Innovation Centre, which aims to promote faster adoption of automation process of photonics devices assembly. At the gathering, Meridian Innovation runs a demo of their new product – a low-cost miniaturized thermal sensor, and PLC introduced their technical services to support photonics development activities.

Photonics@SG, the annual conference jointly organized by The Photonics Institute (TPI) and LUX, received a total of 150 attendees at an NTU's Auditorium on 26th November. It is our great honour and pleasure that renowned photonics researchers Prof Din Ping Tsai (National Taiwan University), Prof Sir Peter Knight (Imperial College UK), Prof Ben Eggleton (University of Sydney) and Prof Satoshi Kawata (Osaka University), spoke at the conference around the main theme of new photonics materials, and local researchers presented their research outcomes. At the Conference, LUX members, DSO National Lab, Lighthaus and Palomar Technologies were invited to speak on the industry trends and challenges in each's business domain, giving the academic their view from industry's perspective. Apart from these 3 LUX members, Denselight, II-VI, OptoSigma, Silterra, Sintec, together with 6 Centres/Programme under TPI, exhibit at the conference podium area.

It is gratifying to see that Photonics@SG is becoming a platform to Industry, Academia, Researchers, Innovators to come together to discuss the research activities, advancements, ideas and exhibit laser, optics and photonics products.

TPI The Photonics Institute Singapore

LUX Photonics Consortium Singapore

Assoc Prof Zhou's talk was on "NEMS-coupled Photonic Nanobeam Cavities and their Applications" and focused on the integration of nanophotonics with nanomechanics, specifically nanoelectromechanical systems (NEMS) coupled nanophotonic cavities.

*Assoc Prof Zhou Guanya talked about NEMS coupled nanophotonics cavities.*

Asst Prof Robert Simpson spoke on "Phase Change Material Tuned Photonics". These promising new phase change materials can be switched on a sub-nanosecond time scale and display a unity change in refractive index when switched. They are ideal for tuning photonic devices, including photonic resonators in the visible, since they do not require energy to hold their state.

*Asst Prof Robert Simpson spoke on "Phase change material tuned photonics".*

Nanyang Assistant Professor and Singapore NRF Fellow Kim Young Jin, of the NTU Centre for Optical and Laser Engineering (COLE), presented on the topic of "Ultra-precision Metrology and Manufacturing by Ultrafast Photonics", citing examples including: high-precision laser ranging of formation-flying satellites; 3D surface profile measurement of large step-structures for quality assurance of semiconductors; and high-performance flexible/stretchable humidity sensors and photodetectors.

There were speakers from industry too, including LUX Industry members DSO National Laboratories, LightHaus Photonics and Palomar Technologies. Dr Chua Song Liang, Principal Member of Technical Staff, Applied Physics Laboratory, provided an overview of the laser development at DSO. LightHaus' Chief Technology Officer Dr Phua Poh Boon spoke of the company's vision to equip the average person with a spectrometer to uncover the world of spectroscopy with its IP - a crystal attached in front of the camera of a mobile phone. Meanwhile, Mr Evan Hueners, Product Marketing Manager at Palomar Technologies, discussed the topic of "Advanced Photonic Packaging: Empowering IoT and Beyond".


*Asst Prof Kim Young Jin presented "Ultra-precision metrology and manufacturing by ultrafast photonics".*

Photonics@SG 2018 also included an exhibition showcasing the latest photonics technologies and innovations. LUX, TPI and its research centres –Centre for Optical and Laser Engineering, Centre for Optical Fibre Technology, Centre for Disruptive Photonic Technologies (CDPT), the Centre for OptoElectronics and Biophotonics, LUMINOUS!, Silicon Photonics – all had booths at the exhibition area at the foyer of the HSS building. LUX members such as Palomar, II-VI Incorporated, DenseLight Semiconductors, OptoSigma and Silterra – took the opportunities to exhibit their solutions to the local photonics community.

The event's finale saw TPI co-director Prof Nikolay Zheludev present prizes to NTU's Xue Haoran and Zhou Yu as well as SUTD's Dong Weiling for the top three best posters submitted as part of the poster presentation. There were 44 submissions (based on the conference's theme) from academics, researchers, practitioners and students.

*One of three winners of the poster presentation*


*Prof Sir David Payne, TPI Co-Director and Director of the University of Southampton's Optoelectronics Research Centre, delivered the conference's closing address.*


*GOH Prof Subodh with invited international speakers, TPI Co-Directors, NTUitive CEO Dr Lim Jui and Prof Tan Yap Peng, Acting Chair of NTU's School of Electrical and Electronic Engineering*

## SPECIAL THANKS TO

**Platinum Sponsors:**

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# LUX networking participants first to visit Palomar Technologies' new Innovation Center

Participants of the LUX Photonics Consortium 2018 4th Qtr Networking & Technical Talks on 27 November were amongst the first to get a peek at Palomar Technologies' swanky new Innovation Center the first-of-its-kind in Southeast Asia.

The networking session was held in conjunction with the Center's launch and the 60 attendees, representing around 30 companies, visited its Assembly and Testing Laboratory for a demonstration of the complex process of building a photonics package for a sensing optical engine, created by DenseLight Semiconductors.

The Center will give local companies access to expert-designed, automated, complex, photonic and microelectronic assembly processes that are both cost-effective and reliable.

*Participants were attracted by the demonstration of the fully automated photonics package assembly.*

*Mr George Loh, National Research Foundation's Director of Programme spoke at the event.*

Companies can also engage the Center for low-volume prototyping and process development service for the assembly of high-performance packages that enable Internet of Things and 5G wireless networks. Palomar Technologies' process development and package assembly expertise was previously only available in America.

Palomar Technologies is a global leader in total process solutions for advanced photonics and microelectronic device packaging. The launch drew media presence from the likes of The Straits Times and The Business Times and was attended by guest of honour, Mr George Loh, National Research Foundation's Director of Programmes. In his address, Mr Loh congratulated Palomar, and also applauded LUX's efforts for promoting industry and the research community's technical exchange and networking.

LUX Chairman, Prof Tjin Swee Chuan opened the networking event with a recap of a successful 2018, sharing that the Consortium had grown to 54 Faculty and 49 Industry members, an increase of 15 and 19 new members respectively. There were presentations from industry members Palomar Technologies, Nanoveu, PLC Industries and Meridian Innovation.

Other highlights for the year include the organising of 11 Technical Seminars/Workshops, participation in four exhibitions (IOT Asia, TechInnovation, Industrial Transformation Asia-Pacific and Photonics@SG), and a key LUX delegation visit to Berlin in April. Prof Tjin also congratulated Prof Hong Minghui of NUS and Industry Member Phaos Technology for being awarded the LUX Photonics Consortium Industry-IHL Collaboration Seed Grant 2nd Call.

*LUX Chairman, Prof Tjin Swee Chuan presented the highlights of the year to the members.*

**Tech Talks by LUX Faculty members**

Tech Talk 1 | **Group-IV Lasers for Photonic-Integrated Circuits**

Asst Prof Nam Donguk discussed his group's research on highly strained group IV materials on a silicon chip for the realisation of low-threshold on-chip lasers.

- Their innovative strain engineering platforms can create direct bandgap germanium nanowires by inducing more than 5% elastic tensile strain.
- The first experimental observation of low-threshold optically pumped lasing in highly strained germanium nanowires.

Tech Talk 2 | **On-Chip Optical Communication and Computing**

Asst Prof Liu Weichen spoke about his recent work in implementing optical communication and optical computing on a silicon chip from the perspective of computer architecture design. He proposed:

- A new routing technique to boost the performance of the optical on-chip communication network while maintaining its thermal reliability.
- To design a nanophotonic accelerator for deep learning computing in data centres with at least one order of magnitude speed up, as compared to the current fastest device.

Tech Talk 3 | **Sub-wavelength Metallic Structures for Enhanced Mid-IR Detection and Biochemical Sensing**

Prof Zhang Dao Hua shared his group's recent work on surface plasmon resonators (SPRs) and their applications for photonic technology. They have:

- Demonstrated two- and three- dimensional SPR arrays with controllable magnetic resonances from long wave infrared to near ultraviolet, and investigated their application for biochemical sensing.
- Enhanced mid-wave infrared photodetection and made them workable at room temperatures, by integrating metallic hole array with InAsSb based heterojunction photodiode.

Tech Talk 4 | **Optical Coherence Tomography (OCT) for Cellular Resolution Diagnosis**

Asst Prof Liu Linbo discussed how cellular and subcellular information is critical for screening and surveillance of diseases, yet excisional biopsy and histology is time-consuming, costly and associated with complications.

- OCT can help image cellular processes non-invasively within a few millimetre of skin depth without delay in diagnosis.
- It may also help to reduce the examination costs and save hospital resources.

**The LUX Industry members who presented at the event were:**

Meridian Innovation, a fabless semiconductor startup incorporated in Singapore. It develops cost-effective and high-performance Thermal Imaging Sensor-based solutions for commercial applications.

Nanoveu, a leading provider of thin film-based nano structures that shape vision when viewed through high-resolution smart devices.

Palomar Technologies, the global leader of automated micro-optoelectronic assembly machines and related contract assembly services. It specialises in the design and manufacture of automated precision die attach, wire bonding and vacuum reflow machines and processes.

PLC Industries, a service provider in the high-precision engineering arena. PLC provides innovative technologies for Photonic, Biomedical, Imaging and Laser applications.


*Palomar Technologies (S.E.Asia) Managing Director, Mr Rich Hueners*


*Meridian Innovation Engineering Director, Dr Piotr Kropelnicki*


*Nanoveu CEO, Mr Alfred Chong*


*PLC Industries Senior Marketing Manager, Mr Steven Ho*

# Optical Fibre research in TPI, NTU

- **Ultrafast fibre lasers offer compact, affordable high-peak intensity light source for a range of applications.**
- **A LMA fibre with high nonlinearity suppression can be a serious contender for ultrafast high-power fibre lasers.**
- **A hollow-core fibre has opportunities for industrial uses (i.e. beam delivery).**

*Material processing*

The short-pulse high-power laser is at the forefront of laser research and driving new applications from high-field physics to material processing.

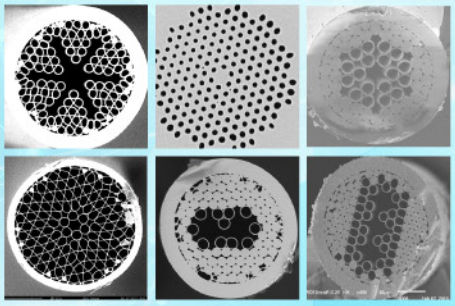
A fibre-based ultrafast laser offers unique characteristics including high repetition rate and power scalability. Together, the two characteristics could support exciting new applications such as 5D data storage, remote micro-bot manufacturing, space broom, and a table-top X-ray source, to name but a few. As the laser uses fibre as a gain medium, a specialty fibre is at the heart of the technology's advancement to meet the demands of these future applications.

In their hope to provide a route towards compact and power-scalable ultrafast fibre lasers, Asst Prof Yoo Seongwoo's group has been working on a large-mode-area (LMA) fibre development. Unlike the rod-type photonic-crystal fibre (PCF) currently dominating the ultrafast fibre laser space, the target fibre has a simple step-index structure that enjoys full access to the legacy of fibre technology and fibre components.

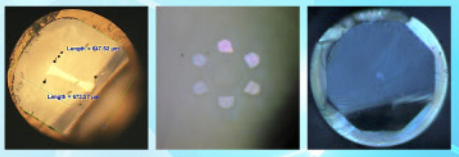
The main challenge of obtaining LMA fibre is related to nonlinearity suppression. Conventionally, efforts to suppress the nonlinear effects have focused on increasing the core size. However, a recent discovery suggests that a new nonlinear effect – transverse mode instability (TMI) – becomes worse in a fibre with a larger core. Hence, instead of increasing the core size, Asst Prof Yoo's group is looking at approaches to shorten the fibre length as well as find a new design for the TMI suppression.

A hollow-core fibre cages light in an air core, providing much reduced light-matter overlap which is the basis of a range of new applications. In particular, hollow-core fibres are a possible technological platform to meet industrial demand for beam delivery of ultrafast laser, mid-IR or UV light sources. Furthermore, hollow-core based fibre components can offer a new dimension in manipulating light without material-related limitations.

Asst Prof Yoo's group is working towards the realization of hollow-core fibre components for beam splitting and combining to handle high intensity lights. The in-house development of light coupling in a multiple hollow-core fibre supports their vision of hollow-core fibre components. Thanks to the minimum light-material interaction, the components will have useful applications in handling mid-IR or UV where conventional fibre components cannot reach.



*Hollow-core Fibres*



*Large Mode Area Fibres*

# Minister Heng Swee Keat wishes LUX member companies success in his Budget Speech

Minister for Finance and National Research Foundation (NRF) Chairman Mr Heng Swee Keat shone the spotlight on LUX Photonics Consortium and Industry members Nanoveu and Technolite in his recent Budget 2019 speech.

*Minister for Finance and NRF Chairman, Mr Heng Swee Keat's visit to NTU and LUX Photonics Consortium.*

He spoke about Nanoveu's partnership with Nanyang Technological University (NTU) to develop a prototype of a high-tech screen protector that will allow long-sighted users to see clearly on digital devices without their glasses, and Technolite's work in lighting the Helix Bridge and Jewel Changi Airport in "scintillating ways", and its investment in research and innovation to develop new way of façade lighting with NTU.

Mr Heng said: "I wish Nanoveu and Technolite success, to light up our lives and to let us see better!"

He had met the two companies on a visit earlier this year to NTU and the LUX Photonics Consortium.

In his Budget 2019 address, Mr Heng also spoke about building Singapore's position as the Global-Asia Node of Technology, Innovation and Enterprise. He mentioned LUX as an example of efforts in investing in R&D in local universities and research institutes, and supporting companies in innovation.

*Minister for Finance and NRF Chairman, Mr Heng Swee Keat*

*LUX Photonics Consortium Chairman, Prof Tjin Swee Chuan*


*Technolite Managing Director, Mr Michael Chia*

During the visit, Chairman Prof Tjin Swee Chuan had given Mr Heng an overview of the Consortium's vision and mission, and its achievements over the past three years. LUX is proud to have showcased two research collaborations between The Photonics Institute (TPI) at NTU and local SMEs Technolite and Nanoveu, to the Minister

Mr Michael Chia, Managing Director of Technolite, presented its transformation journey from a local lighting distributor to a company that has expanded internationally to Asia and Europe. In order to compete in the global market, Technolite recognises the importance of creating its own innovative products. Therefore, it signed a collaborative research project on a unique waveguide for façade lighting with TPI. Technolite also works with TPI on another daylight-harvesting project.

*Nanoveu CEO, Mr Alfred Chong (left) and COO, Mr David Symons*

Nanoveu's CEO, Mr Alfred Chong and COO, Mr David Symons jointly presented their start-up's journey of making use of nano-imprint technology to deliver vision-based consumer application. Nanoveu is currently collaborating with researchers from TPI to address presbyopia, a universal eye problem that affects people above the age of 40-45. Their proposed solution is a nano-imprint technology-based screen protector for mobile devices that correct presbyopia.

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# Industry News

**Meridian Innovation: Stealing the limelight at CES 2019 and Open house at Singapore office.**

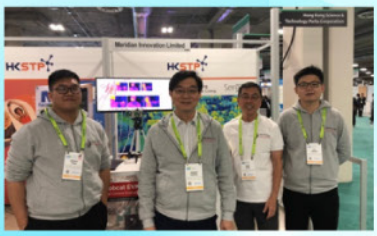

*Meridian Innovation's new office at Vision Exchange*

Meridian Innovation's new invention that allows one to see the invisible was anything but (invisible) at tech trade fair Consumer Electronics Show (CES) 2019, which took place in Las Vegas from 8 to 11 January.

The LUX Industry member's tiny SenXor, a low-cost, low-power thermal imaging sensor that can be built into any device, attracted attention from both media such as The Business Times and a few big players.

SenXor helps users to "see" in the dark by tracking temperature differences. It can be used in autonomous vehicles as well as in home security systems, to track movement.

There was more good news for Meridian Innovation that same month as it celebrated the opening of its new office at 2 Venture Drive, #11-08 Vision Exchange, on 25 January.



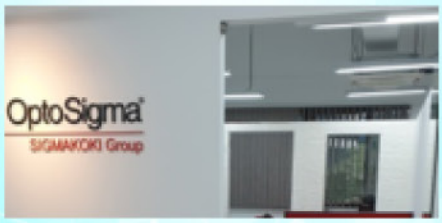
*Meridian Innovation's co-founders Hasan Gadjali and Hock Leow at their CES 2019 booth, flanked by application engineers Adrian Yuen (left) and Ted Cheung (right).*

**OptoSigma to better serve Southeast Asia from new Science Park home**

LUX Industry member OptoSigma, a global manufacturer of quality laser components, microscopes and optical application systems, has incorporated its Singapore office since 11 Feb 2019.

Located at The Curie at 83 Science Park Drive, the office will serve the Southeast Asia region.

With over 40 years of experience, OptoSigma builds laser components such as optics, opto-mechanics and motion control, and has a wide range of application systems for R&D and applications of measurement, inspection, evaluation and analysis in semiconductor, flat panel display, biomedical, and optical sensing & communication.

### Phaos Technology and OptoSigma jointly debut new optical design at SPIE Photonics West

OptoSigma recently demonstrated the OptoNano product prototype at its SPIE Photonics West 2019 show booth, which was visited by over 1,600. The event is the world's largest for photonics technologies.

OptoSigma's parent company SIGMAKOKI had co-developed the new optical design with fellow LUX member Phaos Technology, and supported by the National Research Foundation's Competitive Research Programme. Phaos Technology is an advanced optics technology startup founded by Prof Hong Minghui of NUS, while SIGMAKOKI is a global supplier of quality laser components and application systems


*OptoNano demonstrates game-changing optical imaging capability at super-resolution.*

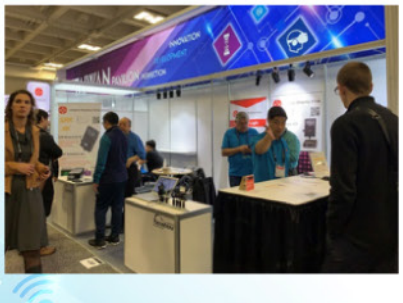
OptoNano offers nano-scale imaging capability in ambient air and works in non-contact mode to solve the characterisation challenges for biology, chemistry, semiconductor and other industries. The companies plan to launch the product early next year.

### I spy EyeFly3D at CES 2019 – Nanoveu's showcase


Provider of thin film-based nanostructures Nanoveu, a LUX Industry member, drew the crowds at leading tech trade fair Consumer Electronics Show (CES) 2019 with its signature EyeFly3D product. The EyeFly3D can deliver 3D with the impression of depth, on high-resolution mobile phones and tablets – and without the help of 3D glasses.

### Bright start to 2019 for Jasper Display Corp. (JDC)

JDC, a LUX Industry member, started the year strongly as it exhibited at two major events: the Consumer Electronics Show (CES) 2019 in January and SPIE Photonics West 2019 (right photo) in February. At the events, it showcased its kits including the EDucation Kit, an LCoS, Spatial Light Modulator (SLM)-based system for hands-on optical training; 4K resolution SLM Research Kit; and Micro LED Start Kit.

## Local Conferences and Exhibitions

### Industrial Transformation Asia-Pacific (ITAP), 22 ~ 24 October 2019, Singapore Expo


- LUX Photonics Consortium Pavilion - opens for member to sign up for exhibition space, limited space!
- Please contact us to secure space.