

Mega conference brings photonics community to town

Leading international academics, researchers and practitioners from the international photonics family convened in Singapore from 31 July to 4 August for a mega conference comprising the 12th Conference on Lasers and Electro-Optics Pacific Rim (CLEO-PR 2017), 22nd OptoElectronics and Communications Conference (OECC 2017) and 5th Photonics Global Conference 2017 (PGC 2017). The event sought to foster interactions among broad disciplines in the photonics community.

Co-organised and co-sponsored by The Photonics Institute (TPI), this is the largest photonics conference in Singapore this year and saw over 2000 delegates gather at the Sands Expo and Convention Centre. Significantly, it was also the first time in the more than 20-year history of the CLEO-PR and OECC that the two events were held in the Republic.

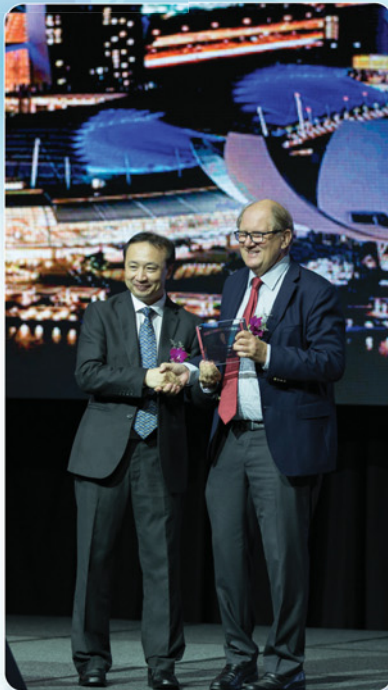
Said the conference general co-chair Prof Shum Ping, Director of the Centre for Optical Fibre Technology: "We received a lot of positive feedback from participants, including that it was one of the best and most well-planned conferences as well as that the close collaboration of the local research scene with industries around the world was impressive."

Prof Shum was also delighted with the response to the lab tour to TPI on the first day of the conference, saying: "All slots were taken up in a short period of time and we had to create additional timeslots to cater to the demand. Through this conference, TPI has definitely helped to create global awareness of Singapore's photonics scene."

The conference exhibition held alongside the mega conference was equally successful, and saw exhibitors from across the globe – such as Yangtze Optical Fibre and Cable, Edmund Optics, and LUX member companies like DenseLight Semiconductors, Sintec Optronics and EINST Technology – showcasing their technologies.

A highlight of the exhibition was the massive TPI pavilion, which housed a total of nine booths: one for each of its seven research centres, as well as for TPI and LUX Photonics Consortium.

The five-day conference also saw participants present their exciting latest research findings, including a first working prototype – by a team from the University of Southampton and TPI – of a data processing metadvice that is compatible with existing optical telecommunications technology. The fully packaged fiberised metadvice is based on a plasmonic metamaterial fabricated on the end face of a polarisation-maintaining single-mode telecommunications fibre. It is anticipated that such metadvice can provide solutions for low-energy all-optical information processing at up to 100 THz as well as quantum information networks.



Conference general co-chair Prof Shum Ping presents a token of appreciation to the Guest-Of-Honour, NTU President Prof Bertil Andersson.



The largest glass greenhouse in the world, Flower Dome at the Gardens by the Bay, was the venue for the conference's VIP reception.

Message from the Chairman/Co-director:

This quarter has been an exciting and fruitful one for both The Photonics Institute (TPI) and LUX Photonics Consortium. TPI has successfully co-organised the biggest photonics conference in Singapore this year, comprising the 12th Conference on Lasers and Electro-Optics Pacific Rim (CLEO-PR 2017), 22nd OptoElectronics and Communications Conference (OECC 2017) and 5th Photonics Global Conference 2017 (PGC 2017). We took this great opportunity to showcase Singapore's photonics research capabilities and ecosystem. Many positive feedbacks were received and we fostered a number of international collaboration links after the conference. LUX Photonics Consortium Industry Members were also invited to the conference VIP reception hosted by TPI at the Flower Dome, Gardens by the Bay, to network with world renowned experts in the field. With the recent new additions, the Consortium has grown steadily to 29 industry members.

Nine new technologies were showcased by LUX Photonics Consortium members at two recent events – NTUitive Start-Up Homecoming 2017 and TechInnovation 2017. We hope such technologies will accelerate accelerating the commercialisation of research and technology adoption by industries.

Last but not least, I would like to congratulate our TPI faculty member Associate Professor Yong Ken Tye who has received the highly prestigious Beilby Medal and Prize for 2017. Established in 1930, this is the first time in 87 years that this highly competitive award is being awarded to an individual from an Asian country.



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



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



Prof Sir David Payne, Co-Director of The Photonics Institute, addresses the audience during the conference banquet at The Ritz-Carlton, Millenia Singapore.

Here are some other research highlights:

- A team of researchers from the Nippon Telegraph and Telephone Corporation, KDDI Research, Inc, Sumitomo Electric Industries Ltd, Fujikura Ltd, Furukawa Electric co. Ltd, NEC Corporation and Chiba Institute of Technology achieved a world record 118.5 Tbit/s transmission through optical fibre with a 125 μm cladding diameter, using a low-loss and 316 km-long full space division multiplexing link incorporating multiple vendor technologies.
- Researchers from China's National University of Defense Technology presented a tandem-pumped superfluorescent fibre source in Master Oscillator Power Amplifier (MOPA) structure with a record power of 3.14 kW.
- A team from the University of Sydney reported a silicon nitride RF photonic notch filter with unprecedented performance including a record-low noise figure of 15.6 dB, high dynamic range, amplification in the passband and ultrahigh stopband rejection.
- An Australian National University and University of Sydney team stored optical data in acoustic waves on a planar waveguide based on stimulated Brillouin scattering (SBS) and demonstrated for the first time that this allows for simultaneous storage at different frequency channels – separated by 100 GHz – without observable cross-talk between the individual channels.

A student-led Photonics Global Student Conference was held in conjunction with the mega conference. Jointly organised by the IEEE Photonics Society (IPS) Singapore Student Chapter, the NTU and NUS Student Chapters of OSA (The Optical Society) and the SPIE Singapore Student Chapter, it sought to promote worldwide communication amongst the younger generation by inviting brilliant students from 14 countries to network and share their research.

The students had the opportunity to attend keynote speeches by the respective presidents of IPS and OSA, Profs Kent D. Choquette and Eric Mazur, as well as talks by an editor of Nature Photonics and a leader from a photonics start-up. They also glimpsed further insights from lab tours to various photonics labs.

The mega conference also served to spotlight Women in Photonics. Sponsored by the IPS, the breakout session saw distinguished female professors, scientists, entrepreneurs and researchers from eight countries – the UK, Australia, China, Singapore, India, Brazil, Italy and Malaysia – sharing experiences and insights related to their research, career and life. The audience also had the opportunity to interact more with the speakers via an engaging panel discussion.

Prof Shum had hoped for the mega conference to be a platform for research collaboration, and he is more than pleased with the outcome.

"The three conferences are all well-known academic research conferences in their own right. As a whole, the event saw members from industries sharing their problem statements and new industry trends, and researchers and academics discussing their latest exciting research findings with them, sparking new ideas."

And he believes that TPI can continue to play a key role in bringing more of such photonics mega conferences to the little red dot. "We have helped create a critical mass of photonics research here and showed that Singapore can be a global powerhouse in the field of photonics. This attracted the attention of the conference committee to choose Singapore as the venue for the mega conference."

A welcome reception at the S.E.A. Aquarium; engaging plenary talks by the likes of Prof William E. Moerner, a 2014 Nobel Laureate from Stanford University; an oversubscribed lab tour to TPI; and TPI's massive pavilion at the conference exhibition.



Technical Workshop the highlight of recent Networking Session

A group of over 50 industry and faculty members gathered for the latest LUX Members' Networking Event, held at NTU's Theatre@The Nest on 28 Sep.



Four new industry members were introduced by Prof Tjin at the start of the session – Advinno, Phaos Technology, ATRYZ and Photizo, bringing the total number of industry members to 29. Prof Tjin then highlighted events that took place in the past quarter, notably the Photonics Mega Conference, which brought the global photonics research community to Singapore; as well as technology showcases such as NTUitive Homecoming and TechInnovation 2017, which further raised awareness of the exciting and advanced photonics technologies being developed within the Consortium. Looking ahead, Prof Tjin spoke about the Singapore-LUX Delegation visit to Berlin. Rescheduled to Apr 2018, the one-week event promises to be highly eventful, with numerous opportunities for technology exchanges and collaborations. The programme includes two days of company visits, as well as an invitation to join in the EPIC Annual General Meeting (usually reserved for EPIC members only!), which is set to be attended by over 200 member companies from across Europe.

Advinno Technology, an Electronics Independent Design House (IDH) which specialises in design, engineering, manufacturing and logistics of semiconductors, electronic systems and turnkey products.



Presentations from industry members were made by new members Advinno and Phaos Technology, as well as two existing members, Coherent Singapore and Denselight Semiconductors. The two newcomers shared their technologies and areas of specialisation, while Coherent and Denselight provided updates of their company and shared some new trends in their field of applications.

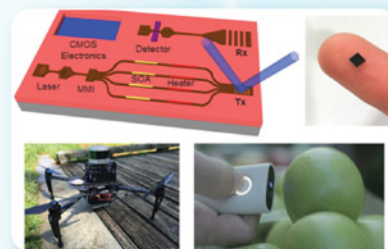
Phaos Technology, a deep-tech startup based in Singapore that focuses on the technical development of advanced optical instrumentation technologies, such as super-resolution optical microscopes.

This quarter's networking event also featured something new – a 60-min technical workshop with talks from three LUX faculty members working in three different areas – Silicon Photonics, Photonic Crystal Fibres and Microspheres.



NTU Assoc Prof Tan Chuan Seng, sharing his work on Ge-on-Insulator (GOI).

Assoc Prof Tan Chuan Seng, from NTU, started off the workshop by discussing how a new platform, Germanium-on-Insulator (GOI), could be promising for future electronics-photonics integration, bringing photonics integration on silicon to another level. Aside from discussing how the manufacturing process could be scalable, Assoc Prof Tan also demonstrated how GOIs enhance devices such as waveguides, photodetectors and light emitting devices, with specific applications in LiDAR, spectrometers as well as on-chip/off-chip communications.

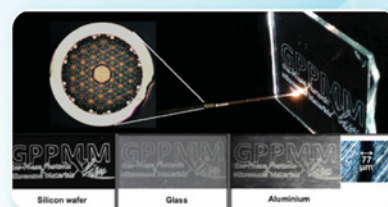


Ge-on-Insulator (GOI) single chip transceivers have potential applications in areas such as LiDAR and spectrometers.



NTU Asst Prof Amir Abdolvand, speaking to the audience on the many possibilities of HC-PCFs.

Asst Prof Amir Abdolvand, also from NTU, then talked about how Hollow-Core Photonic Crystal Fibres (HC-PCFs) could represent the future of laser beam delivery, given their ability to deliver intense, ultrashort laser pulses of excellent beam quality. In addition, HC-PCFs allow access to spectral regions previously inaccessible with conventional optical fibres, such as infrared (2 – 7 μm) and ultraviolet (100 – 300nm). Such fibres provide excellent opportunities in areas such as medical surgery, high-power-high-precision manufacturing processes as well as novel fibre-based light sources.

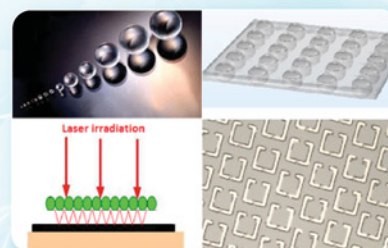


Hollow-Core Photonic Crystal Fibres (HC-PCFs) are capable of excellent laser beam delivery and can be used for processing different materials, with a spot size as small as 77 μm achievable.



NUS Prof Hong Minghui, highlighting his research focus on Microspheres for nanoscopy and surface nanopatterning.

Finally, Prof Hong Minghui from NUS, also co-founder of Phaos Technology, shared on the interesting possibilities of Microspheres – unique optical components used not just for light-based nanoscopy (able to observe features as small as 50 nm in non-contact mode), but also for laser surface nanopatterning, in which the microspheres are arranged in an array to deliver sub-100 nm feature resolution, large area (cm scale), maskless and high speed surface patterning. Prof Hong's technology has been used to fabricate various functional micro and nano-structures, such as 2D or 3D metamaterials, for THz wave applications.



Microspheres applied in the form of Micro-Lens Array (MLA) for surface nanopatterning, used to fabricate micro/nano-metamaterial structures for THz wave applications.

The technical talks were certainly insightful and engaging, with each speaker fielding questions from different industry member representatives. Having witnessed the lively exchanges between speakers and the audience, the next event on 3 Nov is definitely something to look forward to.

New technologies light up the show



LUX Photonics Consortium members showcased a total of nine new technologies at two recent events, the NTUitive Start-Up Homecoming 2017 and TechInnovation 2017.

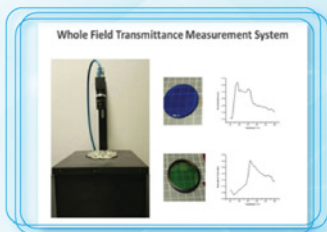
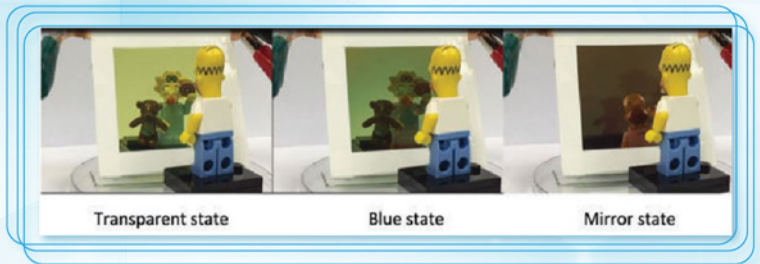
The former event saw NTU start-ups inspiring students, faculty and would-be entrepreneurs through an exhibition, networking and sharing sessions. TechInnovation, organised by Intellectual Property Intermediary (IPI) Singapore, brought together international and Singapore technology providers and seekers.

The technologies – two of which were developed by LUX industry members, with the remaining by LUX faculty members – can potentially be used in Smart City infrastructure, biomedical applications and sensing applications. Here are the new technologies:

The Tristate Electrochromic Device allows for three-state optical modulation – or switching – between transparent, coloured and mirrored appearance on a given surface, primarily glass.

Potential applications: Energy-saving smart windows for building facades and auto-dimming, rear-view mirror displays in vehicles.

Benefits: Consuming minimal power, the coloured state blocks sunlight and heat – allowing users to also reduce air-conditioning usage.



Transcope is a large field of view transmittance measurement system, based on a tuneable light source (Ultraviolet-RGB-Infrared). Images are captured using a monochrome or colour camera.

Potential applications: The technology is able to measure transmittance for smart windows and optical components such as filters and lenses. It can also be used in hyperspectral imaging.

Benefits: Fast, full-field measurement at low cost.



Cameras, sensors and various communication devices are often added onto street lighting poles in an unsightly, ad-hoc fashion. This is where the **IoT (Internet of Things) Pole** comes into the picture.

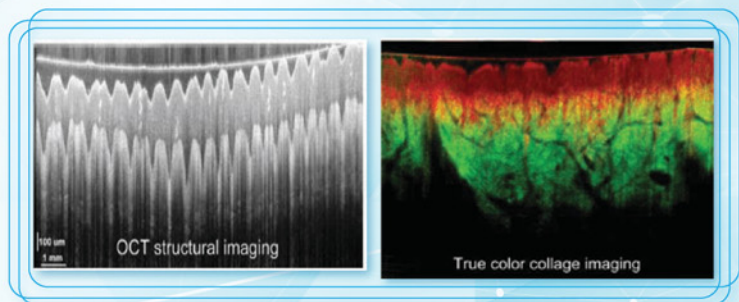
Potential applications: Infrastructure to support Smart City new initiatives, such as video surveillance (CCTV), traffic management and monitoring, wireless communication connectivity.

Benefits: Supports Smart City infrastructure – cameras, sensors and other information and communications technology (ICT) devices can be housed within a single pole.

Hand-held micro-OCT (Optical Coherence Tomography) provides non-invasive, label-free and cellular resolution, 3D images of skin in real-time.

Potential applications: The technology can be used to evaluate skin aging, or developed for use in imaging tools for diagnosis of skin and eye diseases, as well as endoscopic imaging devices for diagnosis of gastrointestinal cancer and cervical cancer.

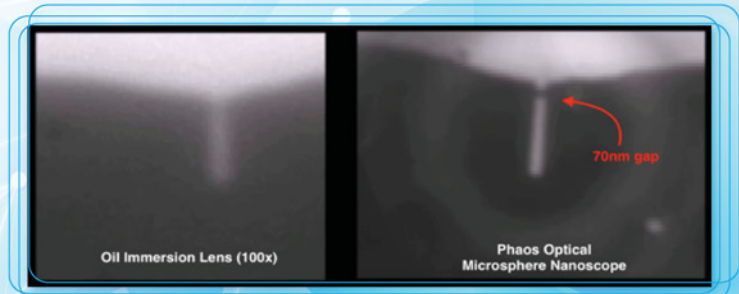
Benefits: Non-invasive, hence facilitates screening for diseases. Less biopsies are required too, reducing the patient burden.



The Microsphere Nanoscope is able to achieve real-time, low-cost, super-resolution imaging.

Potential applications: The nanoscope technology can be used in biology research and clinical laboratory tests, or for quick preliminary failure analysis in a semiconductor production line.

Benefits: A cheaper and easy-to-use alternative to expensive electron microscopes for achieving sub-100 nm resolution under white light illumination at room conditions.



Advanced Functional Fibres and Fabrics is an “all-in-fibre” solution. Via a Lego-like template, many components can be integrated into a single flexible fibre that can achieve multiple functionalities. These include sensing surroundings, communicating, storing and converting energy.

Potential applications: Wearable electronics ranging from health and weight to exercise and training management, large-area monitoring such as environmental sensing, energy generation.

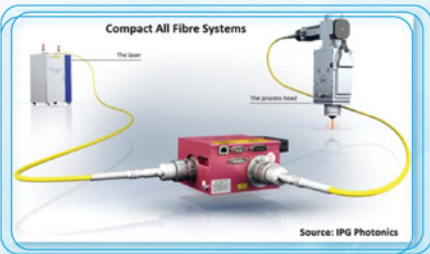
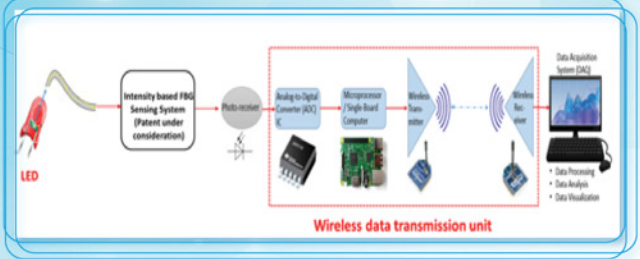
Benefits: Multi-functional, compatible with daily clothing, machine-washable, mechanically tough and flexible.



The **Wireless Fibre Bragg Grating Sensing system** consists of a low-cost LED and a photodiode, coupled with electronic circuits for wireless data transmission.

Potential applications: The system can be used for structural health assessment of civil, mechanical, aerospace and offshore structures, or remote monitoring of oil and gas pipelines.

Benefits: Remote wireless monitoring, compact, low-cost, battery operated.



Unlike a conventional fibre coupler which is limited by its solid core, the **Hollow/Air Core Fibre Coupler** is not confined by material limitations and can be used in mid-infrared or ultraviolet regions.

Potential applications: Mid-infrared or ultraviolet laser cavity or resonator, air core fibre-based resonator or interferometer, sensors, delivery of ultrafast lasers and power splitting.

Benefits: Enable fully-fiberised spectroscopy or laser systems operating in mid-IR or UV wavelengths.



The **Optical Microfiber-Based Sensor** allows for continuous monitoring of metal contaminants in water.

Potential applications: Detect metal ion leakage in water treatment plants.

Benefits: Remote wireless monitoring, fast response time, ppm-level sensitivity. Skilled technicians not required.

LUX's participation at the well-attended TechInnovation 2017 (left) and NTUitive Start-Up Homecoming 2017 (right) was fruitful, with faculty and industry members alike fielding several enquiries from event attendees on these nine exciting innovations. It is hoped that these high-tech showcases will help to accelerate the commercialisation of research and technology adoption by industries.



Industry News

How IoT-Pole Infrastructure will Change the Outlook of the Future Smart Cities

Photizo Global has recently launched a proprietary design technology for the future smart cities in the world. As ICT (Information and Communication Technology) and IoT (Internet of Things) trend continues to drive the future technology developments, they are focusing on one key element, i.e. the IoT Infrastructure itself.

An innovative approach towards developing an IoT infrastructure starts with street pole and IoT integration.

Today, the existing urban street poles are facing huge challenges due to the ever-increasing demand to house various ICT and IoT devices required by the different government services and private sectors.

To bridge this gap, Photizo Global introduces **I.CORE™ Technology** as the platform for deployment and optimization of IoT-Pole.

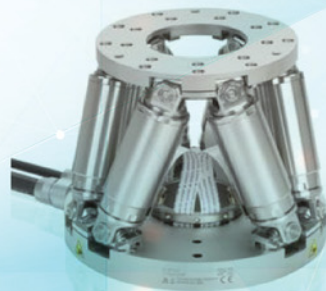
With I.CORE™, the future IoT-Pole grants many new capabilities, including enhanced structural strength, modular parts and installations, smart compartments, individual access, dedicated power and data wiring passageways, non-electromagnetic interference, special IoT compartment made out of polymeric materials, real estate assets and provisioning, flexible add-ons, future exterior design and modifications.

To further develop future capabilities, Photizo Global plans to collaborate and work with innovative minds from various parties such as, technology innovators, system integrators, IoT developers, inventors, telecommunication providers, tertiary and research institutions to make this platform interactive and complete with various intelligence that becomes truly ubiquitous for any new and innovative smart city in the near future.
www.photizo.global/icore



2 new exciting products launched by motion and position specialist - PI (Physik Instrumente)

H-811.I2 is the latest model in PI's proven H-811 Hexapod series providing higher resolution and higher speed. It is especially designed for high duty cycle and long life time in an industrial production environment. This has the same installation space as before, positions with velocities up to 20 mm/s, and is therefore twice as fast as its predecessor. Its six struts work with a resolution of 5 nm. This allows it to achieve the



Precision miniature hexapod for industrial application

high repeatability of $\pm 0.06 \mu\text{m}$. The hexapod covers travel ranges up to 17 mm (in the X and Y axis) or $\pm 6.5 \text{ mm}$ (in the Z axis) and also impresses with its long lifetime of 20 million motion cycles. Loads up to 5 kg can be positioned quickly, with high precision, and over long operating times.

Also designed for industry and high throughput are PI's high precision XY stages V-731 resp. L-731. Targeting laser processing, metrology and inspection, in combination with PI's industrial controllers and software those products are available as turnkey solutions for stand-alone as well as OEM applications. For these application fields, this new series' motorised XY stages work with velocities up to 200 mm/s. The bidirectional repeatability is $0.1 \mu\text{m}$ and minimum incremental motion is $0.02 \mu\text{m}$. The XY stages, which have a size of

only $310 \times 310 \times 80 \text{ mm}$, are offered with travel ranges of $205 \times 205 \text{ mm}$ (8 inches) and it is also possible to offer customised versions.
www.physikinstrumente.com/en/news-events/news/



Precision XY stage for industrial application

Exhibition Opportunities



REGULAR RATE:
SGD 1,500 per panel

Exhibit with us at
IOT Asia 2018 to enjoy
special rate for LUX members!

Entitlements:

- Exhibitor Passes: 2 passes
✓ Access to exhibition floor only
- Hi-Res logo with hyperlink to Institution's website on event website
- Company Profile on event website & mobile app (100 words)
- Panel Booth Counter: 1 (Table Space 1m X 0.5m)
- Bar Stool: 1
- Power Point: 1
- Wastepaper Basket: 1
- Arm Light: 1
- Printing of 1 X A1 Size poster (artwork to be provided by exhibitor, artwork to be high-res in 300dpi, in jpg file or AI format preferred)



For Registration, please email: lux_chairman@ntuitive.sg
For more information, visit the website:
<http://www.internetofthingsasia.com/>

