

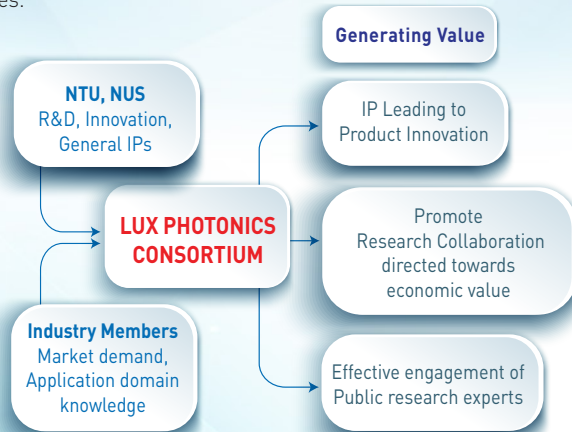


## New initiative to spur photonics industry and universities to collaborate more

We may soon see the photonics industry adopting more intellectual properties (IPs) and innovative technologies developed at universities.

This after the LUX Photonics Consortium Industry-IHL Collaboration Seed Grant was launched on 3 November at the LUX Members' Networking Event.

It hopes to encourage LUX industry members to adopt technology and IPs developed at universities, namely NTU and NUS, through supporting small-scale collaborative projects.



Seeding of Industry-Universities

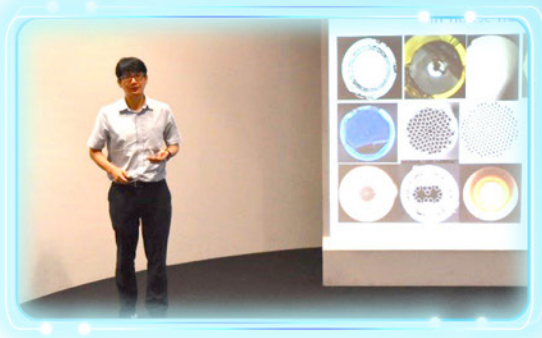
The grant will back projects that are innovative, technically sound, and commercially viable. Each collaboration must be between a LUX Photonics Consortium "Full Industry Member" and LUX Faculty Member, and should support the efforts of the company evaluating the potential of the IP or the technology know-how of universities. The project duration should span no more than 12 months. Granted projects will obtain funding support of up to \$100,000 and will require co-funding of \$10,000 in cash and \$20,000 in-kind from the LUX industry member.

The LUX Members' Networking Event saw a good turnout of over 60 attendees comprising faculty members from NTU and NUS, LUX industry members from 16 companies, and invited guests from nine companies.

Besides the announcement of the grant, the event at NTU's Research Techno Plaza saw the introduction of technologies and solutions by LUX industry members ATRYZ and Hylax Technology.

Founded in 1951, ATRYZ is a comprehensive, coordinated manufacturer with three key divisions: Rubber and plastic; Metal and component; and Electronics Solution, where it has developed a wide range of products including organic light-emitting diodes, optical film and infra-red sensors.

Hylax Technology – formerly known as Hypertronics before its acquisition by Coherent, Inc. in 2010 – provides laser-based solutions and integration for industrial needs. Led by owners with over 20 years of industry experience, Hylax looks to be a one-stop shop for customers' laser process manufacturing needs.



Asst Prof Yoo presenting a variety of special fiber that he developed

The session also included technical talks by LUX faculty members and NTU academics Assoc Prof Tang Dingyuan, Asst Prof Yoo Seong Woo and Asst Prof Wei Lei.

Asst Prof Yoo introduced the Air Core Fibre Coupler, which is fabricated

## Message from the Chairman/Co-director:

As this is the first newsletter for 2018 and with the Chinese New Year just behind us, I would like to take this opportunity to wish all our readers a very happy and prosperous year ahead. 2017 has been a fulfilling year for TPI and LUX. As we move into 2018, we hope to explore greater synergy within the photonics research ecosystem and new areas of research interests, while continuing our drive towards industry engagement and alignment.

LUX has continued to see a steady growth in the number of industry members. We would like to extend our welcome to new members, Pro-Health Water Technologies, Shimadzu (Asia Pacific), JPT Electronics, Sigmakoki and ULVAC. We are glad that you are able to join us and we look forward to engaging you for your technology needs.

I would also like to congratulate our faculty members, Associate Professor Wang Qijie and Associate Professor Tan Chuan Seng on their award of the Competitive Research Programme (CRP) funding from National Research Foundation (NRF). In Prof Wang's project, a compact analyser will be developed based on innovative designs in achieving high performance quantum cascade lasers and broadband high performance photodetectors. For Prof Tan's project, the team will develop key components such as on-chip laser, which can be seamlessly integrated into the conventional silicon fabrication technology. More detailed descriptions of these two projects can be found in the articles of this newsletter.

During the last LUX networking event on 3rd Nov 17, we launched the LUX Seed Grant and have since received many enquiries and generated much interest. This seed grant aims to help our industry members identify IPs and expertise within the university that can enhance the company's existing portfolio of products. We do hope that through this seed grant, we will be able to foster more collaborations between industry and faculty members.

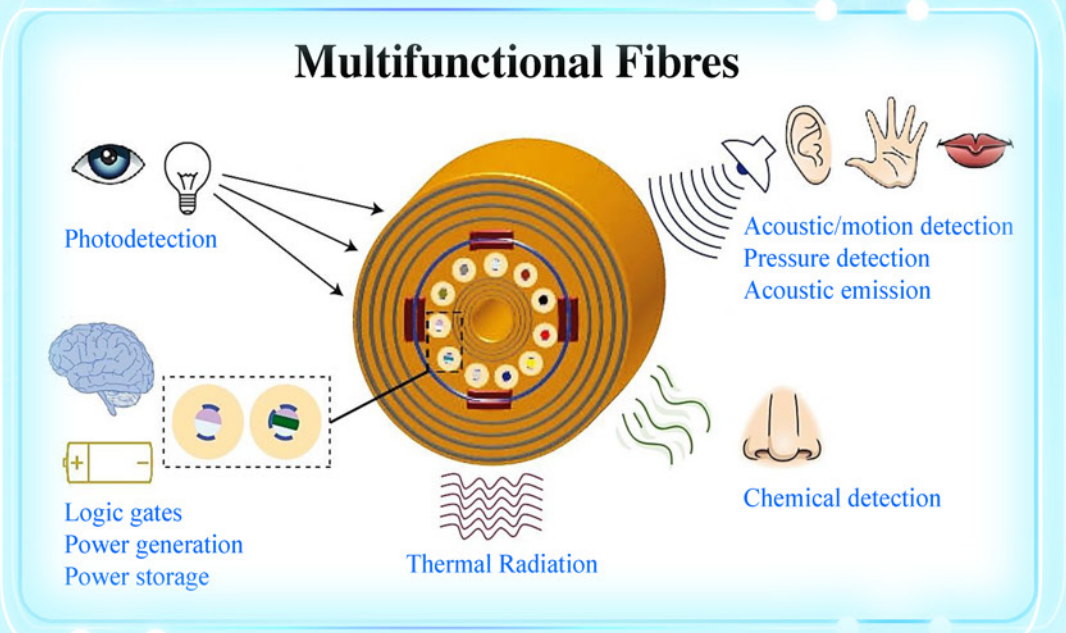
Finally, I want to emphasize that this consortium is your consortium. While we try our best to facilitate in various ways, we also look to you for your strong support of our activities. Do feel free to provide us your feedback so that we can work towards a consortium model that works in our local context.



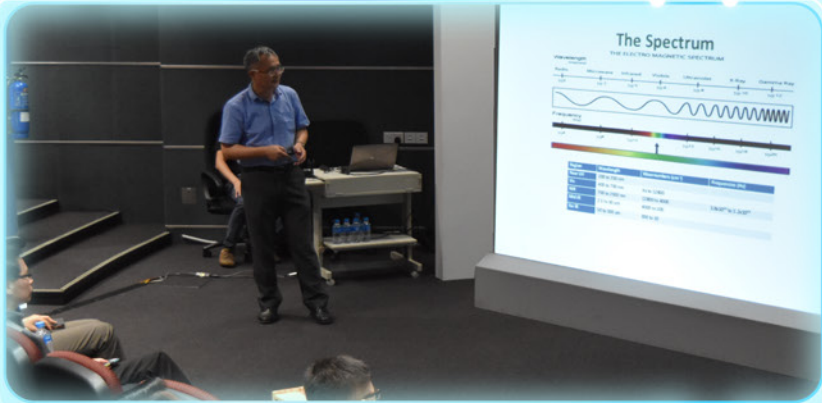
An initiative of both Nanyang Technological University (NTU) and National University of Singapore (NUS), supported by National Research Foundation (NRF), Singapore.

using micro-structured fibre fabrication technology. Its applications include fibre ring cavity, ultrafast laser delivery and splitting, fibre interferometer and fibre sensors. The technology is an improvement on conventional fibre couplers, which are limited by their solid core and thus cannot be used in the likes of mid-infrared spectroscopy, sensing and life sciences applications.

Asst Prof Wei shared his Advanced Functional Fibres and Fabrics that enables the seamless integration of a multiplicity of functional components into one flexible fibre. He spoke on how this presents new opportunities for extending fibre applications in numerous fields, such as to see, hear, and sense their surroundings, store and convert energy, communicate, and monitor health.



*Prof Wei's revolutionary multifunctional fibres can enable a wide range of applications*



*Assoc Prof Tang introducing development of Mid-IR ceramic lasers*

Finally, Assoc Prof Tang spoke on the fabrication of rare earth ions (such as  $Tm^{3+}$ ,  $Ho^{3+}$ , and  $Er^{3+}$ ) doped transparent laser ceramic materials and the development of mid-infrared ceramic lasers. He explained that such lasers have the potential to be used in applications including remote sensing, laser surgery and materials processing, and that NTU has the capability to fabricate high-quality laser ceramics for lasers with wavelength in the range of 2 and 3  $\mu m$ .

The technologies and innovative solutions presented by the LUX faculty members garnered much attention from the companies present. It is expected that they will soon step up their interest and evaluate the potential of these technologies, with an intention to use them to innovate their processes and product offerings.



*The LUX Members' Networking Event on 3 November saw over 60 attendees comprising LUX faculty and industry members.*



# Meet the leading lights of the NRF's Competitive Research Programme

The local photonics scene has been a strong beneficiary of the National Research Foundation (NRF) Competitive Research Programme (CRP) Funding Scheme over the years.

Last year, NTU Assoc Prof Tan Chuan Seng's research on "Germanium-Based Materials for Silicon-compatible NearIR and Mid-IR Light Source" became the latest photonics project to be presented and considered favourably under the CRP scheme since its inception in 2007. The scheme aims to encourage multi-disciplinary cutting-edge research that will benefit Singapore and its society.

Previous photonics projects to be awarded under the CRP scheme include the "Next Generation Broadband, Compact, Ultra-Sensitive, Real-Time, Tuneable Laser Spectroscopy Analyser" and "A Cutting-edge Silicon based Mid-IR Photonics Platform for Emerging Communications and Sensing Applications" by NTU Assoc Profs Wang Qijie and Wang Hong respectively.

## A silicon photonics platform for mid-infrared communications and sensing applications

- Steep growth in transmitted data volumes necessitate more sophisticated photonics technologies to forestall a capacity crunch
- Spectral bands in the mid-infrared region offer a promising solution
- Strong potential for sensing applications too as this region contains unique absorption fingerprints for many gases and molecules

Assoc Prof Wang Hong's Silicon Photonics affiliated programme is developing a technology platform for mid-infrared communications and sensing applications by combining the attractive properties of group IV materials with the advantages of III-V photonics.

The team has investigated both silicon and germanium-on-silicon platforms due to their good transparency, high nonlinear coefficients, refractive indices and modulation effects in the mid-infrared range.

He says: "With continued steep growth in transmitted data volumes in all media, there is a widely-recognized and urgent need for more sophisticated photonics technologies in both the core and access networks to forestall a 'capacity crunch' in the medium term."

"One promising solution is to use new spectral bands in the mid-infrared region for optical communication systems. This region also contains unique absorption fingerprints for a number of gases and molecules, meaning that photonics devices designed for this wavelength range have potential applications in environmental and biochemical sensing, homeland security and medicine."

Under the CRP scheme, Assoc Prof Wang Hong and team have to-date developed new silicon and germanium materials and silicon photonics passive devices operating in the mid-infrared range, high-performance Antimony-based lasers working at 2  $\mu\text{m}$  wavelength, as well as demonstrated mid-infrared Silicon-on-Insulator modulators for high-performance communications and sensing applications. They have also successfully established a mid-infrared silicon photonics platform and demonstrated state-of-the-art performance with silicon photonics devices at 2  $\mu\text{m}$  and 3.8  $\mu\text{m}$  wavelengths.

The team is currently working with industry partners to explore the potential for commercialization of this platform. Assoc Prof Wang Hong's hope is that in 1.5 years, it will be open to silicon photonics designers globally for the design and fabrication of mid-infrared silicon photonic devices and circuits for various applications.

## Realising a fully-integrated transceiver chip via a germanium-on-insulator (GOI) on silicon platform approach

- GOI is an ideal platform for a truly monolithic integration approach for diverse components
- The chip will be miniaturised, reliable and cheap to produce

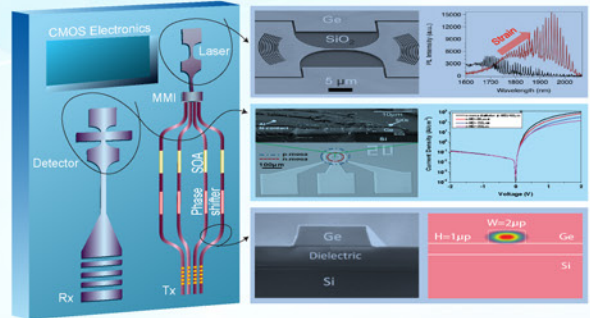
For Assoc Prof Tan, he is looking to "develop the key components, especially on-chip laser that is compatible with silicon, which can be seamlessly integrated using conventional manufacturing technology to realise a miniaturised, reliable and low-cost chip for applications in autonomous machines, handheld devices and beyond".

At present, autonomous machines such as vehicles, robots and drones rely on

Light Detection and Ranging (LiDAR), a laser-based radar-like detection system. However, LiDAR systems are unreliable, bulky and expensive.

This is a limitation also seen in the sensors used in hand-held personal devices capable of chemical, biological and environmental sensing.

Hence Assoc Prof Tan's desire to develop a fully-integrated transceiver chip. He has proposed a germanium-on-insulator (GOI) on silicon platform approach, explaining: "Waveguides, photodetectors and grating can be realised on the GOI platform. It is an ideal platform for a truly monolithic



Germanium-on-insulator substrate allows for the seamless integration of Ge-photonics and Si-electronics. The Ge-photonics components include passives, light source and detector.

integration approach for diverse components."

In addition, lesser atmosphere scattering and absorption losses can be achieved by using highly-strained germanium i.e. pushing operation wavelength to approximately 2  $\mu\text{m}$  versus working at 1.55  $\mu\text{m}$ .

His target is to have a prototype ready in three years. Ultimately, this could benefit Singapore's Smart Nation drive, for instance by facilitating the roll-out of fully autonomous vehicles to the general public. Other potential applications are in the areas of robotics and drones.

## Compact and accurate mid-infrared laser-based spectroscopy diagnostic techniques

- Laser spectroscopy techniques will particularly benefit the oil & gas and chemical industries
- A highlight of the project is the broadly tuneable single-mode quantum cascade laser
- The laser will have wide tuning bandwidth and high accuracy, yet be small in size and affordable

Finally, Assoc Prof Wang Qijie's programme seeks to develop compact and accurate mid-infrared laser-based spectroscopy diagnostic techniques. These can then be used for real-time identification of specific substances through advanced signal processing methods.

He shares: "Laser spectroscopy in the mid-infrared region (approximately 3 to 14 micrometre) is an emerging technique for quantitative analysis of multiple compound chemicals. The region is the so-called 'fingerprint' region in which gas molecules have unique and strong absorption features."

Currently, the quantum cascade laser is one of the more successful semiconductor lasers used in the mid-infrared region, but achieving wide tuning bandwidth, low cost, high accuracy and small size remains a challenge. Assoc Prof Wang Qijie's broadly tuneable single-mode quantum cascade laser looks to address these issues.

His project, which is being developed at NTU's Centre for OptoElectronics and Biophotonics, also seeks to improve the sensitivity of broadband mid-infrared photodetectors. A compact analyzer will be developed based on these innovations to quantum cascade lasers and photodetectors.

Assoc Prof Wang Qijie is excited by the potential applications of this laser spectroscopy technique. He enthuses: "I would expect it to be of particular benefit to the oil & gas and chemical industries – Singapore is the region's chemical hub and has a strong oil & gas industry too."

"If successful, our technology will allow accurate and real-time inspection of chemical leakages in these industries. It could also be used on a daily basis to check for chemical hazards and contaminations."

He is hoping that, within the next three to five years, the team will have a high-performance laser spectroscopy prototype ready for testing in the field.

# LUX-TPI jointly organises a technical seminar on Photonics Integrated Circuits with the Embassy of Netherlands

A technical seminar featuring two renowned researchers in the field of Photonics Integrated Circuits was conducted at NTU on 20th Nov 2017. Professor Ton Backx, CEO of Photon Delta and president of the Institute for Photonic Integration at the Eindhoven University of Technology (TU/e), spoke passionately about his vision of photonic integration being the start of the next industrial revolution, while Professor Wang Hong from the School of EEE, NTU, shared his insights on the development of silicon photonics devices for mid-infrared (MIR) applications.



Speakers Prof Ton Backx and Prof Wang Hong, flanked by Dr Soo Choi Pheng and the delegation from the Netherlands.

Jointly organised by LUX, TPI and the Embassy of the Kingdom of the Netherlands, the seminar was the culmination of a follow-up discussion between Professor Tjin Swee Chuan and Ms Elsbeth Nijhuis, a representative from the embassy under the department of the Holland Innovation Network, which focuses on facilitating collaborations between Singapore and the Netherlands in the areas of innovation, technology & science. The two parties had met earlier in the year, during a roundtable meeting at the Photonics@SG 2017 Conference held at MBS.



More than 50 participants were present at the event, filling the Executive Seminar Room to near its full capacity.

Held at the EEE Executive Seminar Room and hosted by Prof Tjin, the event attracted a largely positive turnout of more than 50 participants, comprising faculty, researchers, students, representatives from LUX industry members and a delegation of business representatives from the Netherlands.

During his talk, Prof Ton Backx pointed out several key challenges facing the future globally, especially that of managing the rapid growth in data traffic and exponential increase in energy consumption. According to him, the likely solution would need to come from the nanoscale integration of photonics, electronics and spintronics. The proposed solution could tackle other major challenges such as security,

mobility, food processing and healthy ageing. He also devoted a significant portion of his presentation to introduce Photon Delta, the integrated photonics eco-system model for the Netherlands, which coordinates the activities of companies and R&D institutes involved in photonic materials, photonic integrated circuits and photonic systems.



Prof Ton Backx, providing an overview on how Photonics Integration is likely to kick-start the next Industrial Revolution.

Prof Wang Hong then spoke about his ongoing Competitive Research Programme (CRP) – the development of Si-phonic devices covering the MIR wavelength range, which was discussed in detail in the previous article. From the encouraging response garnered in terms of crowd turnout and significant interest generated from the session, it is safe to say that one can look forward to more of such events being organised in the near future.



Prof Wang Hong, discussing his CRP project on developing Si-Photonics devices for mid-IR applications.



Light refreshments served as the perfect backdrop for participants to mingle and know each other better.

# Industry News

## Congratulations! to the entrepreneur who "Transform, Reinvent" - theme of the Entrepreneur of the Year Award [EYA] 2017



Michael Chia  
Chairman, Passionate Group Lighting

On 27 November 2017, Michael Chia, the Managing Director of Technolite (a founding industry member of LUX), was named double award winner of the 29th Entrepreneur of the Year Award (EYA) 2017 at the Award Presentation Ceremony, in his capacity as the Group Chairman of Passionate Lighting Group. He was awarded the titles of:

- "Established Entrepreneur" for 2017, and
- "EYA for Enterprise" for exhibition of strong leadership and entrepreneurial capabilities.

Inaugurated in 1989 by the Rotary Club of Singapore, EYA is the oldest award in Singapore that honours local entrepreneurs who have shown outstanding performance as business owners in their respective fields, for both emerging and established enterprises. Since 1992, the award has been co-organised by the Association of Small & Medium Enterprises (ASME). The award prides itself on having high qualifying criteria, rigorous rounds of site visits and a stringent judging process.

The "Established Entrepreneur" award aims to uncover veteran businessmen who possess the tenacity to bring their enterprises to the next level, as well as innovation to revitalise their

business and keep abreast with the changing times.

Michael's entrepreneurial journey started in 1991, while he was in his mid-twenties. At that point in time, he lacked working experience and product knowledge. Energy and determination were his strongest assets, which tided him over the 1997 Asian financial crisis. There was a brief venture into the food & beverages industry in 2000, but that wound up sometime later, due to the overwhelming challenges of maintaining two vastly different fields of business. With his focus re-centred



on the lighting industry, Passionate Lighting Group was awarded many projects. These included the revitalisation of the Singapore River for the 2008 Grand Prix, lights enhancement of Orchard Road, as well as lighting up of the Helix Bridge, Marina Promenade and Gardens by the Bay, to name a few. Between 2014 and 2016, the Company aggressively extended their regional network of offices with the "Technolite" branding. In 2015, having noticed the trend of developing "Smart Cities" globally and the evolving Internet-of-Things (IoT), Michael anticipated a change in his business landscape. It was an opportunity for the company to realise its aspiration of being the global forerunner in the lighting industry. Michael quickly formed a team of dedicated specialists to focus on new developments and this eventually led to the start of his new company, Photizo Global. Michael's journey has indeed been challenging and rewarding. He is an inspiration to other entrepreneurs and companies, who seek to transform, expand internationally and become future home-grown MNCs.

## Inauguration of Shimadzu Innovation Centre Asia Pacific

On 17 November 2017, Shimadzu Corporation, manufacturer of both analytical and medical instruments, opened the Shimadzu Innovation Centre (Asia Pacific) in Singapore.

Shimadzu has also established Innovation Centres in United States, Germany, and China as part of their "Synergy Innovations with Partners" initiative.

The newly opened centre advocates the 'Academia-Industry Partnership', targeted at commercialisation of fundamental achievements accomplished by academic communities and organisations.

The opening ceremony was graced by Dr Teruhisa Ueda, President and CEO, Shimadzu Corporation and VIPs from Economic Development Board Singapore, A\*Star, Japan Embassy and National University of Singapore (NUS).

During the ceremony, prominent guests and collaborators from NUS Environmental Research Institute (NERI), National Research Foundation, NUS Industry Liaison Office, Zicom Medtacc, Nanyang Technological University, NTUitive and Changi General Hospital, shared their areas of focus in support of these collaborations.

Shimadzu Corporation was founded in 1875 in Kyoto, Japan. In 1989, Shimadzu (Asia Pacific), a subsidiary and the Asian headquarters of



Shimadzu Corporation, was established in Singapore. Shimadzu provides sales and technical support, application development, analytical/scientific instruments and medical diagnostic equipment for a wide range of industries. One of Shimadzu's most notable achievements was attaining the Nobel Prize in Chemistry in 2002 for a new technology created by Koichi Tanaka. [www.shimadzu.com.sg](http://www.shimadzu.com.sg)

# Local Conferences & Exhibitions

## IoT Asia 2018 Updates

We are pleased to announce that two of our consortium members, ATRYZ and Pro-Health Water Technologies, will be exhibiting at IoT Asia together with LUX and TPI. Faculty members will also be showcasing technologies that are close to commercialisation, such as air-core fibre beam couplers, wireless FBG sensors and piezoelectric photonics sensors. We would like to invite all industry and faculty members to come by and support our booths!



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### Entitlements:

- 1 x counter
- 1 x barstool
- 1 x 13 Amp power point
- Complimentary marketing and media exposure (where applicable) on Lux Photonics Consortium Members

For registration, please email: [lux\\_chairman@ntuitive.sg](mailto:lux_chairman@ntuitive.sg)

For more information, visit: [www.ConnecTechAsia.com](http://www.ConnecTechAsia.com)

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