ILLUMINATE

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LUX-OptoNet Partnership Sealed at Virtual Delegation Meeting of OptoNet and LUX

The Virtual Delegation Meeting of OptoNet and LUX on 18-19 May saw the signing of a Memorandum of Understanding (MoU) by LUX and OptoNet, which represents the leading players of Photonics in Germany's Jena region.

Held virtually over Zoom, the event organised jointly by the two organisations saw more than 150 and 30 plus attendees from Singapore and Germany respectively on both days. A*STAR, Enterprise Singapore (ESG), NTU and 37 LUX member companies together with 18 OptoNet member companies were represented.

LUX Chairman Prof Tjin Swee Chuan and Mr Thomas Bauer, OptoNet's Managing Director, kicked off the event by launching the LUX-OptoNet partnership.

Through the MoU, the two organisations will seek to support one another in reaching out to the European and Singapore markets, government representatives, funding schemes and other consortia; provide qualified contacts and recommendations to address the other innovation ecosystems, and more.

The event also saw virtual visits to Edmund Optics' aspherical lens prototyping facility in Woodlands, Singapore, and Jenoptik's operations spanning Jena's "optical valley". Edmund Optics is a leading producer of optics, imaging and photonics technology, while Jenoptik focuses on optical technologies with the majority of its products and services provided to the photonics market.

Message from the Chairman/Co-director:

I hope all of you are staying safe and healthy amidst the uncertain COVID-19 situation in Singapore.

In May, we held our 2nd LUX Quarterly Members' meeting of 2021, hosting our LUX members and our partner companies from OptoNet, which represents the leading players of Photonics in Jena, Germany. The two-day event saw a strong turnout of 100 and 87 attendees on Days 1 and 2 respectively, and I was pleased to sign a Memorandum of Understanding (MoU) with OptoNet on behalf of LUX Photonics Consortium during the event.

With this agreement, we hope to provide you with greater support in reaching out to the European market. When the COVID-19 situation improves, we also look forward to co-hosting visits of delegates of trade missions and business events, as well as joint participation in trade shows, conferences and workshops. You can read more about the 2nd LUX Quarterly Members' event and MOU signing inside this newsletter.

We also recently welcomed five new industry members to the LUX family: Innowave, Leuze, Masstron, Protoking and TNC Optics. You can read more about them in this issue of the newsletter. Please join me to extend our warm welcome to them.

These are difficult times for all, so let's continue to support one another within our photonics community and emerge stronger together!

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

Prof Tjin Swee Chuan

NANYANG TECHNOLOGICAL UNIVERSITY SINGAPORE | The Photonics Institute | LUX PHOTONICS CONSORTIUM SINGAPORE

The Virtual Delegation Meeting allowed OptoNet and LUX member companies to learn about their counterparts via company presentations and network over 1-to-1 Business Matching.

There were also presentations by the OptoNet member companies (asphericon, Carl Zeiss, Digital Innovation Hub Photonics, Jabil Optics, Leibniz Institute of Photonic Technologies, LightTrans, OptixFab, Vistec Electron Beam) and LUX member companies (Advanced Micro Foundry, CompoundTek, DenseLight Semiconductors, iLaser, LightHaus Photonics, Palomar Technologies, PI, PLC Industries, SG Dynamic Optronics). This was an opportunity for the companies to share their technologies and solutions, as well as the potential collaborations, with their overseas counterparts.

Said Dr. Christian Schindler, Project Manager, Carl Zeiss Jena GmbH: "I was very much interested in the presentations of the Singapore photonics community. Great insights! We'll have further talks and investigation with some of them regarding a possible partnership."

Mr Soma Sankaran, DenseLight Semiconductors' VP Sales & Marketing, said: "Virtual forums like these are extremely important during these challenging times, to give Singapore companies like DenseLight a platform to showcase our home-grown technology and reach out to new markets and customers. Thank you to the LUX Photonics Consortium for organising this event with OptoNet and we look forward to more such meetings."

Over the two-day event, 40 prearranged sessions of Business Matching were held for the LUX and OptoNet member companies to network and explore business opportunities with their counterparts. The 40 sessions took place after the companies' presentations on both days. On average, each company got to engage with at least 3 to 4 of their overseas counterparts.

Said Peter Grundschok, Sales Manager for SIOS Messtechnik GmbH: "Great event, I'm very much enjoying it. In times of travel restrictions, having six personal conversations with potential partners is very valuable."

The German Federation of Industrial Research Associations (AiF) and ESG also presented on the Germany-Singapore SME Funding Programme, which promotes cross-border R&D collaborations between Singapore and German SMEs. Participating companies receive joint funding support from ESG and AiF. Applications are welcome for the 4th edition of the funding programme, which commenced in June (submission deadline closes 7 December 2021), and a project consortium must involve at least one Singapore SME and one German SME.

Tech Talk Highlights

"The Dawn of a Fabric Revolution – advanced functional fibre"
Assoc Prof Wei Lei, Centre Director of the Centre for Optical Fibre Technology (COFT), NTU
Assoc Prof Wei Lei discussed how the demonstration of flexible functional fabrics enables the realisation of wearable full-body sensing system to monitor various physiological signals. He presented his research group's recent progress on fibre-shaped devices to enable precise control on both functionality and device density.

"III-V/Si-photonic Tunable Lasers", Assoc Prof Wang Hong, Centre Director of Silicon COE Programme, NTU, and Dr Brian Sia, CompoundTek Pte Ltd
LUX members Assoc Prof Wang Hong and CompoundTek discussed their work under the Industry Alignment Fund – Industry Collaboration Projects. Together, they are looking at development of commercially viable, wavelength-tunable hybrid silicon laser diodes at O-, C- and L-band.

What attendees said about the Virtual Delegation Meeting of OptoNet and LUX

"Well-organized event to initiate future bilateral collaborations between the Singapore and German photonics industry."
Dr. Phua Poh Boon, CTO, LightHaus Photonics

"I was impressed by the programme and the information regarding the expertise of the LUX members. On the other hand, it was a great opportunity to present Jenoptik to so many Singapore players. For us, it is important to stay attuned to international innovation topics. Looking forward to the cooperation."
Dr. Jan Werschnik, Chief Innovation Officer, Jenoptik AG

"Thank you for the great event. The discussion we had with one of the LUX members led to further talks regarding a real project."
Dr. Jörg Wagner, LEJ | Leistungselektronik Jena GmbH, Member of the Board of OptoNet e.V.

Introducing OptoNet

OptoNet is one of the world's leading photonics regions, located in Central Germany. In Jena and around more than 16,000 people work in more than 200 companies and research institutions. The ecosystem with multinational players and highly innovative SME and science organizations like Fraunhofer, is strongly connected with the history of Carl ZEISS, who once founded his enterprise here.

Today the value chain in optics and photonics in the region ranges from components, optical systems and metrology, laser technology, materials, optical fibers and biophotonics. Key expertise lies within optical design, freeform optics, ultra precision manufacturing, ultra short pulsed laser technology, and point-of-care technologies in life sciences.

OptoNet as the institutionalized network organisation offers technology workshops and gatherings, brings people together, supporting cooperation in research and business development. Successful international regular events are the Ultra Precision Manufacturing Workshop every two years, the International Summer School Advanced Lens Design and many business-related meetings.

Since the foundation in already 1999, OptoNet is strongly involved in projects of workforce development and edcuation collaborating with faculties and photonics education centers. With an export rate of 70 percent internationalization plays a crucial role in the cluster activities. Strongly connected with photonics networks in Western Europe and the US, OptoNet is more and more reaching out to Asian partners. The strong innovation and cooperation potential with the members of LUX Photonics Consortium in Singapore is therefore highly appreciated among OptoNet members.

The cluster management of OptoNet has its office in the center of Jena. Managing director is Thomas Bauer, who held leading positions in photonics industry before joining OptoNet in 2017.

Contact person: Ms Anke Mank, Manager International Affairs,
https://optonet-jena.de/?lang=en

Series of Photonics Research Capabilities

Meet the NUS team making mid-infrared sensing on a chip

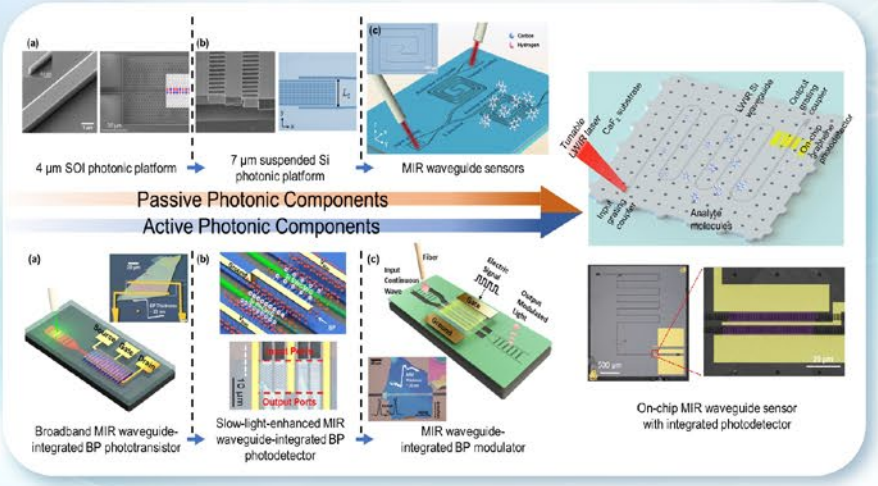
Mid-infrared (MIR, 2-20 μm) overlaps with abundant molecular absorption fingerprints and provides a powerful spectroscopy tool for molecule identification and quantification in widespread sensing applications such as environmental monitoring, industrial process control, and medical diagnostics. Conventional spectrometers rely on free-space optics that are bulky, expensive, and power-hungry, while integrated photonics promises the ability to perform the same analysis using chips with high compactness, low cost, and low power consumption, enabling the deployment of sensor networks for future realization of the Internet of Things (IoT).

Dr. Chengkuo Lee and Dr. Kah-Wee Ang and their team including Dr. Yiming Ma, Dr. Jingxuan Wei, Dr. Bowei Dong, and Dr. Li Huang have developed on-chip MIR spectroscopic sensing systems at the Center for Intelligent Sensors and MEMS (CISM), NUS. Various MIR passive and active photonic components that are indispensable for the construction of chip-scale sensing systems are investigated to demonstrate significant advances in system integration and on-chip sensing demonstration.

For passive photonic components, they have developed silicon-on-insulator (SOI) platform in 3.6-4 μm and suspended silicon platform in 6.3-7.1 μm. Waveguides were demonstrated with low propagation losses of ~2 and ~4 dB/cm, respectively. Various functional building blocks were developed for light coupling, routing, and splitting. Waveguide components with slow light effect and Vernier effect were also developed, which can be utilized to enhance the performance of waveguide sensors, detectors, and modulators. Employing these two platforms, N2O and toluene gas sensing were demonstrated as examples at their absorption peaks of 3.89 and 6.65 μm, respectively, with low limit of detection (LoD) and fast response time. N2O is a greenhouse gas and is the dominant ozone-depleting compound. Toluene is massively used in chemical industries (such as paints, agrochemicals, fuel, etc.) and is an indicator for diagnosing lung cancer in exhaled breath.

The integration of passive waveguides with active components (including photodetectors, modulators, and lasers) is essential for the realization of chip-scale sensing systems. Emerging two-dimensional (2D) materials are promising for active photonic components, whose layered lattice structure eases waveguide integration and enables novel electronic and optical properties. Utilizing black phosphorus (BP), the team developed the first MIR waveguide-integrated photodetector beyond 3 μm. They further improved the BP photodetector performance through the integration with photonic crystal slow light waveguide. On top of photodetectors, they also demonstrated the feasibility of using BP for MIR waveguide-integrated modulators.

Leveraging the synergy between and combining the experience gained from the MIR silicon photonic platforms and the MIR waveguide-integrated 2D-material-based active components, the team further developed a simple and high-yield transfer printing method to fabricate robust silicon-on-CaF2 (SOCF) waveguides with integrated zero-bias graphene photodetectors in 6.3-7.1 μm. Utilizing this integrated system, on-chip detection of 0.72% toluene was experimentally demonstrated. This is the first on-chip waveguide sensor with integrated photodetector beyond 6 μm and the achieved LoD is the lowest among reported on-chip MIR sensors. In addition to the demonstration of



Development roadmap of chip-scale MIR spectroscopic sensing system.

toluene sensing, it is worth highlighting that the presented system would be capable of sensing various molecules and their mixtures due to its broadband behavior and the inherent selectivity of MIR absorption spectroscopy. Multiple molecules in mixtures could be discriminated and quantitated using this single device, such as ethylene (with an absorption peak at 6.92 μm, widely used in chemical industries and is the most produced organic compound), ammonia (with multiple absorption peaks from 5.6 to 6.9 μm, widely used for the production of fertilizers, cleaners, and pharmaceutical products) and benzene (with an absorption peak at 6.75 μm, widely used as a precursor to manufacture other chemicals), etc. It is also noted that the bandwidth of our system is mainly limited by the grating couplers. By replacing them with butt couplers, even larger bandwidth is expected and absorption fingerprints of more molecules can be covered, enabling wider sensing applications.

The CISM NUS is always looking forward to engaging in meaningful collaborations with both industry and academia members for the further development and commercialization of on-chip MIR spectroscopic sensing technologies.

Accolades

Prof Nikolay Zheludev appointed Distinguished Fellow of the Institute of Advanced Studies (IAS) at NTU

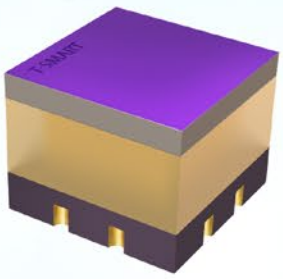
The Photonics Institute Co-Director and Centre for Disruptive Photonics Technologies Director Prof Nikolay Zheludev has been appointed as a Distinguished Fellow of the Institute of Advanced Studies (IAS) at the Nanyang Technological University (NTU), Singapore.

Prof Zheludev who is also the NTU President's Professor in Physics will assume the honorary appointment for an initial term of three years.

IAS@NTU was established in July 2005 with the mission to provide an interactive catalytic platform for eminent scientists and scholars in the pursuit of enduring knowledge. The Institute catalyses and communicates cutting edge and ground-breaking science and engineering studies by the NTU research community. It also facilitates ideas exchange and fosters collaboration across disciplines between local and international researchers in high impact areas.

Industry News

Moveon Technologies and T-SMART Head for Their Own style of Heterogenous Integration – The Hybrid2 Momentum Approach



Moveon Technologies and T-SMART are working towards a greater collaboration and co-development work. It will be a technology by definition, that refers to the integration of separately manufactured components into a higher-level assembly. In our case, Moveon and T-SMART will endeavour to develop the simple 3D integration of a MEMS device and wafer level optics, coupled with wafer level processing that allows the direct bonding of multiple wafer substrates, creating a true wafer level packaging platform with "on chip IR optics". This allows for greater flexibility of product and application potentials. T-SMART realized that there is more than one way to develop a leading-edge design. While there may be functions of a design that requires a higher level of performance with both leading edge and some bleeding-edge technologies, it is all about implementing a total functioning product as a part of a single homogeneous piece of technology. We termed this heterogeneous integration manufacturing concept as our "Hybrid2 Momentum – H2M" approach. H2M will open up an exceptional improvement in InfraRed Detector manufacturing and produce a high degree of thermal feedthrough simplicity through the potential of on chip optics. Moveon and T-SMART both believe that through the companies' continuous efforts of technology sharing and advances, a higher level of our H2M approach will occur, and the manufacturing processes will eventually achieve a lower cost of production of the thermal detectors.

EXFO: Scalable, Multi-vendor Setups Deliver Fast, Accurate PIC Testing

Photonic Integrated Circuit (PIC) technology is tackling bandwidth stress in the transceiver industry – stress driven by performance and cost pressures of burgeoning data centers and evolving high-speed/5G networks. The latest transceivers and passive components are smaller, faster, cheaper, and greener than their bulk-optics counterparts. And with the use of Process Design Kits, PIC designs are no longer limited to conventional formats.

Testing new PIC designs requires innovative solutions that integrate various types of manufacturing and test instrumentation. Automated, scalable, multi-vendor setups are needed, according to EXFO, the communications industry's test, monitoring and analytics experts.

Through memberships in consortiums including LUX Photonics, EXFO has already joined forces with multiple vendors to create integrated solutions in PIC testing such as these recent collaborations:

EXFO PIC testing collaboration with HPE and MPI

EXFO worked with Hewlett Packard Enterprise (HPE) and MPI Corporation to offer streamlined PIC testing solutions that provide low power, integrated, and automated PIC testing at the wafer level, with high reliability, flexibility, and scalability. Measurements support applications from R&D lab testing to full-scale manufacturing.

AEPONYX, a PIC inventor and micro-optical switch leader, needed a solution for faster processing of advanced silicon photonics devices. A fully-automated, opto-electrical probing system with ultra-fast optical test instrumentation -- capable of generating a large data set for device characterization -- was required. EXFO collaborated with Maple Leaf Photonics (MLP) and AEPONYX to enable a customized measurement system that dramatically increases test speed by a factor of 10.

Tower Semiconductor's foundry-based requirements included scalability and customization to support the different test setup requirements of each PIC device. And the company's large customer base needed accurate test measurements traceable throughout the PIC ecosystem. EXFO's CTP10 passive optical component test system integrated with MPI Corporation's TS3000 wafer disc handler system optimized Tower Semiconductor's PIC testing.

More information on EXFO's PIC testing solutions is available here.

Wavelength Opto-Electronic acquires Precision Molding Technology for Consumer Electronics Optics

Plastic & Glass Molded Lens

For decades, the manufacturing processes of optical lenses have been time-consuming, energy-intensive, expensive and optical lenses of complex specifications are challenging to produce in volume. Precision Mold processing technology such as Injection and Glass Molding from Wavelength Opto-Electronic is a flexible manufacturing solution addressing all the above issues. When the low-cost, fast, efficient and high volume production of optical lenses are requisite, this cutting-edge technology has replaced the need for old manufacturing techniques.

The plastic and glass are the raw materials used to produce optical lenses with this technology. Injection Molding is defined simply as a process through which plastic material melted and injected into molds. Glass Molding is defined simply as a process through which glass material softed and finalized in core. The mold material is cooled to harden, and then it is removed from the mold. Now it is ready to use with exact specifications for many different applications. A single tool is adequate for producing higher volumes with the necessary surface quality for each production run. The temperature and pressure are the key parameters that need to keep in control during the whole process.

The Plastic and Glass Molded lenses with customized needs for user-specific applications are feasible to produce using this technology. There are 1-50mm size molded lenses available from Wavelength Opto-Electronic that are applicable not only in the consumer market but also in the laser, medical and metrology fields.

New Industry Members Introduction

Innowave Tech began as a consultancy and quickly grew into one of the leading Industry 4.0 companies providing end-to-end solutions in Singapore.

Delivering on our vision of leveraging on our deep domain expertise and experience of the semiconductor industry to serve the AI transformation needs of other industries, the company now provides a full range of products and solutions – from industrial digitization to intelligence transformation – to greatly improve productivity, quality, and tool efficiency across multiple manufacturing sectors and industries.

- Inspection Station (Marco/Micro)
- IoT Inspection
- AR Inspection
- Mobil Detection

Real Time Detection, Real Time Response

Categorized into two or more of our 4 verticals – Computer Vision, Data Ecosystem, Industrial IoT, and Mechanical Automation – our solutions include smart sensors and computer vision for image judgement and classification, automated macro and micro inspection, customized AGVs and intelligent stockers, as well as Data Ecosystem design, development, and integration. Today, we work with some of the world's leading companies in semiconductor, equipment, and precision electronics manufacturing.

Our team consist of veterans and leaders from different industries with different expertise: I4.0 Consultants, ICT System architects, Software specialists, Data scientists, Operation and business leaders, IIoT and Data integration experts.

One of our crown jewels is a major technological breakthrough in the creative use of optics system and computer vision techniques that reduces cost while significantly increases the overall capability in defect detection, recognition, and classification for our customers.
A local tech SME – Powered by Artificial Intelligence, Driven by Innovation

Leuze is an international sensor expert for automation technology. We have been forerunners for innovations and technological milestones in industrial automation for more than 50 years. The success of our customers is what drives us. Yesterday. Today. Tomorrow.

Our high-tech product range includes a variety of different sensors for the field of automation technology. Among these are switching and measuring sensors, identification systems, and data transmission and image processing solutions. As a Safety Expert, we are also focused on components, services and solutions for safety at work.

We are primarily targeting industries in which we have in-depth, specific application know-how and many years of experience. These include intralogistics and the packaging industry, machine tools, the automotive industry as well as laboratory automation.

DDLS500 – Product for Optical Data Transmission

RSL, MLC - Product for safety at work

In recent years, Leuze has been investing in leading technologies on robust industrial communication for smart factory applications.

Leuze setup the Technology and Market Centre in Singapore in 2015 with the vision of a deeper understanding the Asia market and providing the products and services that better meet customers' requirements. Leuze Singapore hence is constantly looking for key partnership and collaborative opportunities with other members in the consortium to create new and innovative solutions for our customers.

Masstron, established in Singapore since 1995, has envisaged that Fiber Optics would revolutionize the way people interact, work, and play.

Today, Masstron is one of the market leaders, with a mission to provide the key benefits in total communication solutions in Fiber Optics & Network infrastructure. Building on experience which we gained over the years, Masstron has evolved into a One-Stop Communication Supplier and Service Provider to serve your communication demands and needs.

Our customer-focused solutions include cable and accessories, manufacturing of jumper cables, provision of on-site termination and testing services. We support total communication solutions to Data Communication and Computer Network industry, Transport, Industrial Automation and Process Control Environment, Shipyards and Offshore, Oil & Gas industry, Military and Security Arena, OEM and Contract Manufacturers.

Masstron has further ventured into the medical industry with the development of a contactless vital signs monitoring solutions, the Smart Mat and Life Checker System, which makes use of core Fiber Optics technology and licensed patent from A*STAR. In application of ISO 13485 (for medical devices) pending, Masstron will look to manufacturing the Smart Mat and Life Checker System in Singapore, where the solution is of high applicable for hospitals, hospice and homes, when constant monitoring of vital signs are required ensuring the highest comfort for its users.

PROTOKING is one of the few hybrid Innovation Acceleration company that have vast experience across many industries. We are a one-stop solutions hub that empowers the bridge from design to manufacturing, with applied Design Thinking for Product Innovation from lab to market. Our services include Designing, Prototyping, Contract Manufacturing and DFMA (Design for Manufacturing and Assembly). We provide consultancy and services at any stage of the product development.

PROTOTYPE is a necessity no matter the stages of development you are at. Based on your objectives, different types of prototypes serve a different yet important purpose. However, getting the correct prototypes is always something many developers are having difficulties or misconception with. We are in the industry long enough to see this happening again and again. You either have not enough budget or you misused the budget. But there actually need not be a huge budget if you know exactly what to do. That is where we are here to help, we are committed to bring you a step closer to commercialization with every dollar you spent on prototyping.

Prototypes examples.

LEARNING and integrating continuously is what drive Protoking, help us understand your innovations and we can help you maximise your dollars, bringing you closer to realise your commercialisation goal.

Upcoming Events

2021 3rd Quarter Members' Meeting

Date: 9 Sep 2021,
Thursday
Time: 2.00pm to 3.30pm

Venue: NTU (TBD)
Mode of Participation:
Tentatively Hybrid
(In-person & Online Zoom)

German Business Delegation Singapore - Electronics & Photonics

Date: 20 to 24 Sep 2021 Keep a look out for the details!

TechInnovation 2021

Date: 28 to 30 Sep 2021
LUX will be showcasing
innovative Tech Offers in this digital event.
Stay tune for more information!

Photonics@SG 2021 Conference

Date: 23 Nov 2021
Time: 3.00pm to 6.00pm
Venue: NTU ARC Lecture Theatre
Mode of Participation: Hybrid (In-person & Online Zoom)