Issue 2 • August 2020

Technology. Applied to Market.

THE TRIPLE HELIX

In This Issue:

CEO's Message

Jaffri Ibrahim

Dear Members of CREST,

We have come to the second half of 2020! Together we are adapting to the new norm and reshaping the way we operate to be more innovative, flexible and responsive while consistently delivering value to the ecosystem. I am proud of the resilience shown by our industry partners and community during these challenging times and I remain positive that we will emerge stronger than before. CREST held its inaugural webinar, titled 'Advantage in Adversity: The E&E industry in a post Covid-19 world' on June 18, 2020. Four of our board members made up the panelist for the session and they presented a balanced industry-government perspective on the impacts and key learnings from the pandemic and measures that have been put in place to ensure recovery for the industry. You can read more about the webinar in this newsletter.

In show of solidarity with the tech and innovation community, CREST co-sponsored the 'Forkwell Coronavirus Hack', a virtual hackathon that aims to find solutions for issues related to the COVID-19 pandemic. The 14 day hackathon drew participation from software developers, data scientists and experts in virology and bioinformatics from 32 different countries and using a combination of AI, data analytics and machine learning, they developed solutions that will be shared with governments to assist them to fight the pandemic.

In this issue, find out how we are supporting growth for industries through various programs. You can also read about the GaN on GaN Research Program, where we aim to pioneer upstream LED Research capabilities in the country, alongside collaboration with Nobel prize winner, Professor Shuji Nakamura and academia and industry partners. I sincerely hope that the newsletter has benefited you in some way. We invite contributions from the community; tell us what you are doing in any written form so that we can learn from each other. In the meantime, let's work together and contribute towards building the ecosystem.

The Quest for Next Generation LEDs

Overview

Gallium nitride (GaN) is creating an innovative shift throughout the power electronics world. For decades, silicon-based Metal Oxide Semiconductor Field Effect Transistors (MOSFETs) have been an integral part of the everyday modern world that helps convert energy to power. However, with increasing power density and efficiency requirements and environmental pollution regulations trends, silicon is failing to meet these modern demands. This has led to the rise of GaN in replacing silicon as the backbone of power switching technology as it can meet the growing needs with better power systems efficiency, performance and system cost. Today, GaN is instrumental to the electronics world as it is deemed suitable for myriads of today's technologies including high powered electronics, wireless communications, solid-state lighting, displays and lasers.

CREST's GaN Journey: How it began

Back at its first Strategic Research in 2012, CREST members identified the LED industry as one which it would like to support through its collaborative R&D program by carrying out research activities that could grow the sector's value added. "Recognizing the importance of GaN, we set an ambitious goal. We were looking to capitalize on the global market for GaN Research which is slated to hit USD82 bil by 2024 and to position Malaysia as one of the top 3 LED solutions providers in the world," Jaffri Ibrahim, CEO of CREST said. "The idea was to create a complete LED ecosystem for Malaysia, encompassing front and back end including supply chain and logistics. And we aim to achieve this alongside industry and academic partners through sharing of facilities and resources".

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By sheer coincidence, CREST made headway towards reaching its goal through an annual E&E seminar organized by MIDA. It was there that CREST met with Nobel Prize Winner, Professor Dr. Shuji Nakamura, a distinguished professor of materials at University California Santa Barbara and regarded as a superstar for his blue LED invention. CREST was familiar with the advance research by Nakamura and his team and the accolades he received and approached him on the idea of a technology transfer."Nakamura and his team had different ideas in the beginning, "We were thinking of something deeper, more long term and targeted. The idea was to conduct more industry relevant research that would create IPs owned by Malaysian entities which would make it easier to license the technology to Malaysian companies which will ultimately benefit the country" Jaffri said.

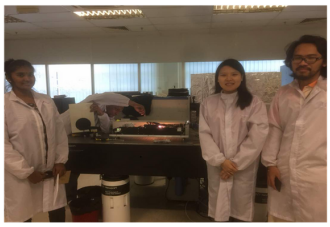
Developing local capability & capacity

The arrangement with Nakamura sees to it that regular visits to Malaysia are made by senior researchers from UCSB while Malaysian students are also admitted to the university's PhD program under the project sponsorship. Two labs that mirror Nakamura's research lab in UCSB were constructed in USM and UM. The idea behind this, is to create as close as possible, an environment for our research community to conduct their GaN research upon returning from UCSB and similarly for visiting UCSB researchers to continue with their research, when in Malaysia. Currently in its fifth year, the GaN Research Program has trained more than 12 scientists and engineers on MOCVD and advanced LED fabrication techniques. It has also produced 70 GaN search experts and engineers and are sponsoring three Malaysian PhD students who are currently in the midst of completing the research program. "The exposure has been invaluable especially for young researchers; many of whom rarely get to engage with industry and senior researchers in such a collegial environment, all while grounded on the research that is their collective enterprise." said Lim Hoo Kooi, Program Director of the CREST GaN Research Program.

Malaysia's GaN Research Network


USM Researchers


UM Researchers


UniMAP Researchers

Monash Researchers

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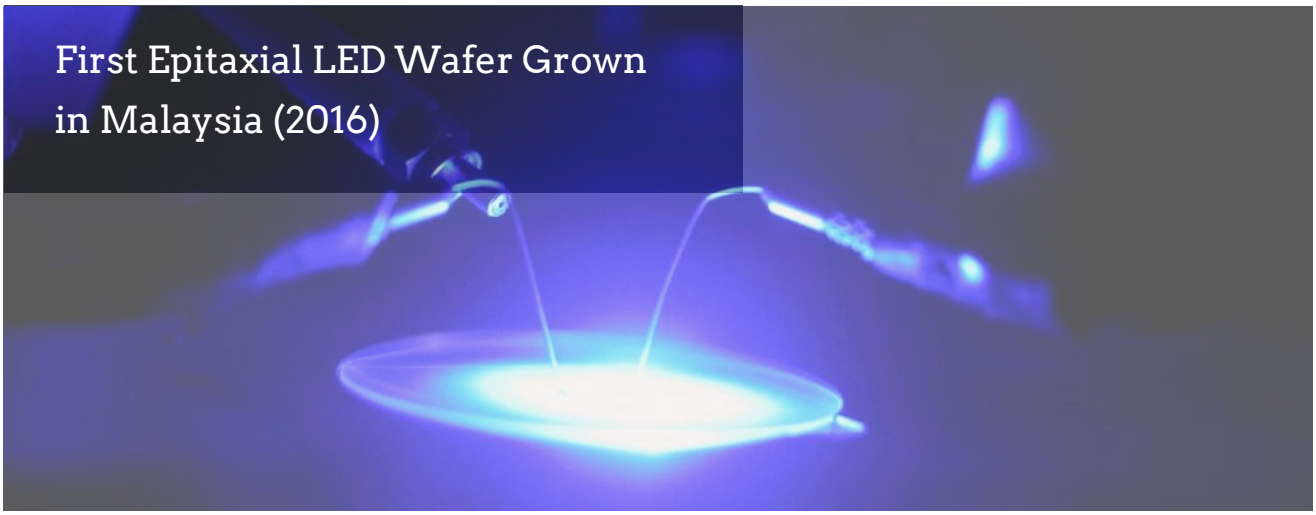

Taking GaN into the Future

The GaN Program has played a leading role in introducing the technology to academia and industry. While the program is centered on light emitting diodes (LEDs), the overall plan spans wider than just that. In the long term, CREST is also looking to create research and commercial opportunities in domains such as Li-Fi, power electronics, lasers and the likes. Bolstering this plan are various CREST collaborative R&D projects that synergize well with the program such as heat dissipation for high power devices, light communication, LED application, LED packing and GaN power electronics.

Capability & Capacity in Local Universities

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Box Article: Gallium Nitride, One of Malaysia's Emerging Techs to the Market

Introduction

III-Nitrides – (Al, In, Ga)N – now, next to silicon are the most important/ highly sought after class of semiconductors because of its relevance in this modern age. They are suitable for myriads of today's current techs including high powered electronics, wireless communications and solid-state lighting, displays and lasers. Impressively, with all said and done, III-Nitrides are still a relatively new class of semiconductors due to previous difficulties achieving low defect crystals and the inability to create a p-type material. Fortunately, Shuji Nakamura and other researchers in Japan were able to solve both of these issues in the early 1990s for which he was awarded the 2014 Nobel Prize in Physics, along with Prof. Akasaki and Amano.

MOCVD - Key Technology for Nitrides

One of biggest breakthrough which enabled the GaN revolution was the design of a novel MOCVD (metalorganic chemical vapor deposition) systems which improved the boundary layer by pushing the reactant gases down to the substrate. Nakamura's novel reactor design allowed him to achieve higher quality crystal growth compared to others. Today, III-Nitride LEDs have revolutionized the lighting and displays industry with the highest achieved EQEs (external quantum efficiencies) over 80%. Through the CREST GaN on GaN research program, UCSB, and Malaysia Academic Institutes (University Sains Malaysia(USM), University Malaya (UM), UniMAP, Monash Univ.) have trained over 12 scientists and engineers on MOCVD and advanced LED fabrication techniques over the past 3 years. Numerous scientific exchanges and extended visits to both Malaysian and UCSB campus have occurred. Recent efficiencies of white LEDs of 110 lm/watt achieved in the program have reached commercially viable levels needed for lighting applications.

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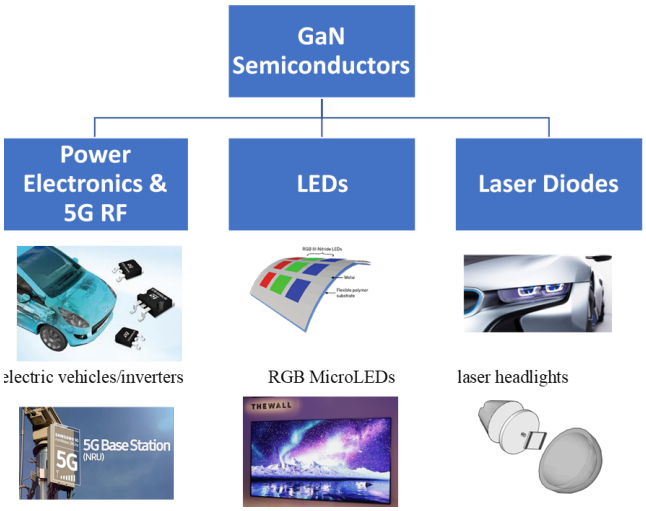
Emerging Business Areas

The MOCVD technology for GaN growth is now being applied to several other large emerging business areas. After solid state lighting, the next big growth engines utilizing GaN materials are power electronics, wireless communications, micro-LED displays, UV LEDs, and Laser lighting. The figure below illustrates these diverse application areas for the III-Nitride semiconductors.



Power Electronics & RF

The power electronics market for wide bandgap semiconductors is predicted to be the next largest market after Solid State Lighting at $60B USD annually. Recently, GaN power amplifiers have been deployed in the base station of 5G wireless networks. Due to the superior radio frequency (RF) power amplification and linearity GaN is playing an ever increasing role in wireless communications. As reported in Semiconductor Today, the GaN RF market will grow at 12% CAGR to over $2B USD in 2025, driven by 5G infrastructure and defense applications.

Micro LEDs

There is currently a growing interest in the use of microLEDs (LEDs with less than ~50 μm dimensions) for next-generation display technologies (wearable technologies, phone displays, projector displays, full-scale displays, and AR/VR applications) due to their superior efficiencies, lifetimes and color qualities compared to LCD and OLED technologies. They offer increased lifetimes, reduced power consumption, increased brightness, wider color gamut, higher pixel densities, better contrast ratios, faster refresh rates and reduced fill factors.

Laser Diodes

GaN based blue laser diodes are currently seeing commercialization in laser TV and laser automotive headlights. By combining a blue laser diode with crystalline phosphors, white the superior brightness and size are enabling new applications of laser light into applications that require the exceptional brightness. Both BMW and Audi released laser based automotive headlighting in 2016, and additional automakers have announced use in future models. Laser lighting offers exceptional safety for nighttime driving with a 1km range.

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Ultra Violet (UV) Light LEDs

UV light has been used for a wide range of applications. Ultraviolet (A) is used as photocatalyst during air purification, sterilization, deodorant, etc. UV light near 308nm is used in phototherapy. UVA and Ultraviolet (B) can be used for curing applications where the light initiates a photochemical reaction that generates a crosslinked network in polymers. This reaction is used by industries including medicine, automobiles, cosmetics, food, science, etc. UVB and Ultraviolet (C) can be used to make certain sensors. UVC can also be used to decompose organics. An emerging application for UV light is in disinfection.

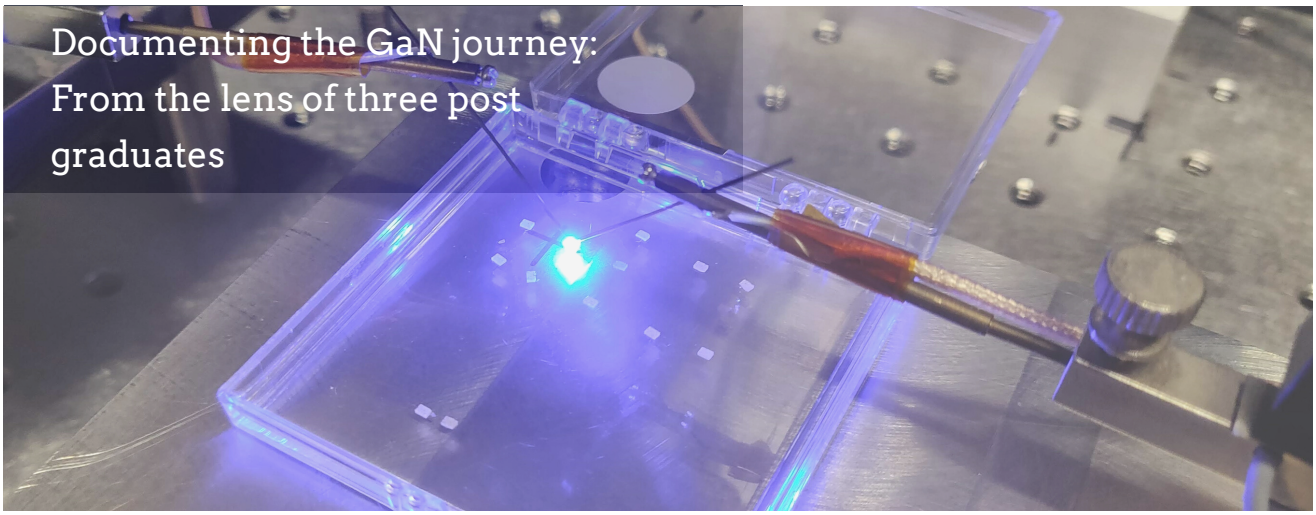
During the COVID-19 pandemic, appropriate sanitation is essential to protecting human health. UVC has been demonstrated to kill bacteria and inactivate viruses. For example, a mask could be put under UV light and be sterilized in just 30 minutes. UVC can also help to disinfect air. A particle filter in a heating, ventilation, and air conditioning (HVAC) system would be used for circulation while a UVC light help to clean the air. This would allow for particles to be filtered out while the light killed any viruses and bacteria.

Within three to four years, disinfection applications will reinvigorate the UV LED market'- Yole Development predicts. Among the different type of devices, UV LEDs will take a higher and higher percentage of market share. In year 2020, UV LED market is predicted to reach $320 million and then $1 billion in 2023.

In summary, III-Nitride semiconductors have seen remarkable progress and commercialization over the last 15 years. MOCVD technology has proven to be the key materials deposition technique used in the manufacture of these advanced solid-state devices. The CREST Malaysia program has played a leading role introducing the technology to Malaysia academia and industry. With new application areas emerging, Malaysian industry now has the opportunity to implement GaN technologies into the marketplace.

Article contributed by:
Steve DenBaars, Shuji Nakamura, James Speck
Solid State Lighting and Energy Electronics Center,
Materials and ECE Departments
University of California, Santa Barbara

Documenting the GaN journey: From the lens of three post graduates



Who we are and how we started our GaN journey.

Clayton Qwah graduated from Imperial College London with a MSci in Physics with Theoretical Physics. His interest in semiconductors came about when he was working on his Master's project, where he was involved in the growth of semiconductor quantum-dot-quantum-wire systems. After graduation, he went on to work as a software architect at an AI startup company where he developed a knowledge base and natural language processor for a chatbot.

Ho Wan Ying studied at Oxford University towards an MPhys in Physics, with a focus on Condensed Matter Physics. It was then that she became interested in semiconductor and device sciences. Her first involvement with optoelectronics came about during her tenure as a research assistantship at University of Malaya, where she worked on synthesis and application of superparamagnetic nano-photonic crystals.

Chow Yi Chao graduated magna cum laude from University of Washington with a double major in Physics and Mathematics. Upon graduation, he interned at OSRAM Opto Semiconductors Sdn. Bhd. and subsequently worked at Texas Instruments Sdn. Bhd., where he was exposed to the world of semiconductors.

Clayton Qwah

Ho Wan Ying

Chow Yi Chao

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Brief background of the project including outcomes, achievements and challenges.

At present, Clayton is conducting experimental and theoretical studies of electron and hole transport within GaN alloy heterostructures. This is part of his ongoing effort to study every section of traditional LED designs. His studies involve using a cutting-edge simulation technique incorporating a mathematical theory called Localization Landscape, which allows for simulating nitride devices, a technique that is a thousand times faster than traditionally used methods. The simulation models are then used to guide his experiments, which include growing test structures using Ammonia Assisted Molecular Beam Epitaxy and fabricating them using photolithography techniques. He recently published a paper, studying holes (a positive analogue of the electron within semiconductors) transport behaviour within Aluminium Gallium Nitride (AlGaN) alloys, where he discovered that undoped AlGaN would act as a barrier towards holes within these structures. This behaviour is removed when the AlGaN is doped with Magnesium, mimicking the design of an electron-blocking-layer (EBL) commonly found in LEDs today. Thus, the study not only shows why the EBL is a necessary element in manufacturing high-efficiency LEDs, but also serves to guide the optimization of III-Nitride devices in the future.

Wan Ying works on the only Electron Emission Spectroscopy (EES) system in the world. EES is a novel technique pioneered by the Solid State Lighting Energy and Electronics Center (SSLEEC), University of California, Santa Barbara (UCSB) and their collaborators at the French National Center for Scientific Research (CNRS), Ecole Polytechnique. EES measures and analyzes the energy distribution of electrons emitted from an electrically biased LED. In 2013, an article was published in which hot electrons generated by Auger recombination were detected in a higher side valley, providing unambiguous proof that Auger recombination is the dominant cause of droop in blue LEDs, settling a decade old debate. Since these electrons originate from the active regions of the device and interact with all layers of the LED, the technique provides useful insights into the workings of all these layers. As such EES paves the way towards rational design of LEDs and will be useful in understanding and addressing the green gap in solid-state lighting.

Yi Chao's research focuses on III-nitride optoelectronics devices. His work involves metalorganic chemical vapor deposition (MOCVD) growth of III-nitride thin films, fabrication, and characterization of III-nitride devices. In particular, he has been working intensively on nitride-based photodetectors and LEDs. Nitride-based photodetectors are promising devices for applications in visible light communications (VLC) or light-fidelity (LiFi) technologies which rely on visible light spectrum for communication rather than the congested radio frequency (RF) spectra. Due to the widespread adoption of solid-state lighting technologies, VLC has garnered significant attention in recent years. His research focuses on the dynamic characteristics of the photodetectors where significant improvements in device speed have been achieved through active region optimization. Aside from that, he works on tackling the efficiency droop problem in LEDs by reducing the deleterious polarization-related fields in the active regions.

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What's in store for the future? How can the learnings from the GaN Research program be utilized for future research, product development or solutions?

Having trained in every aspect of nitride device research, the team is confident that they are able to help CREST develop Malaysia's research ecosystem and bring it up to speed with the latest technological advances. The exposure they received from working with some of the greatest minds in the field have given them valuable insights into the latest developments and have allowed them to hone their understanding of the physics that govern the design and operation of GaN devices. Armed with knowledge and skills, they are able to tackle challenges that may arise during the development of Malaysia's GaN research ecosystem, whilst simultaneously working towards leveling up the country to compete on an international stage.

CREST's role in making this journey possible.

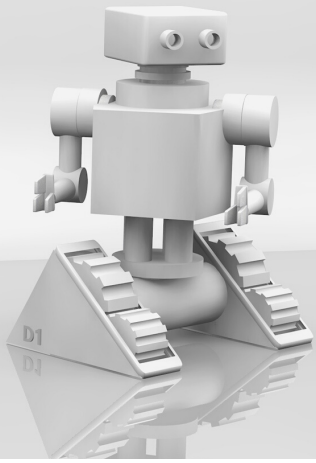
"Without CREST, I would not have had the opportunity to interact and work with the pioneers in the field of GaN research, as well as collaborate with some of the best minds in the field. My PhD has given me valuable insights into the field of GaN devices; thanks to the unique collaborative nature of the Solid State Lighting Energy and Electronics Center, spearheaded by Professor Shuji Nakamura," - Clayton Qwah

"My relationship with CREST began before the GaN-on-GaN program as I was among the first members of The Great Lab initiative in 2014. It was CREST who introduced me to the idea of bridging industry and academia, which ultimately led me on this PhD journey." - Ho Wan Ying

"I'm grateful to CREST for giving me the opportunity to work with all the talented people at UCSB. Working on cutting edge research with state-of-the-art facilities is a dream come true for me."-Chow Yi Chao

Article contributed by:
Clayton, Wan Ying & Yi Chao (pictured here with GaN Program Director, Lim Hoo Kooi
GaN Research Program PhD Students based in
University of California, Santa Barbara

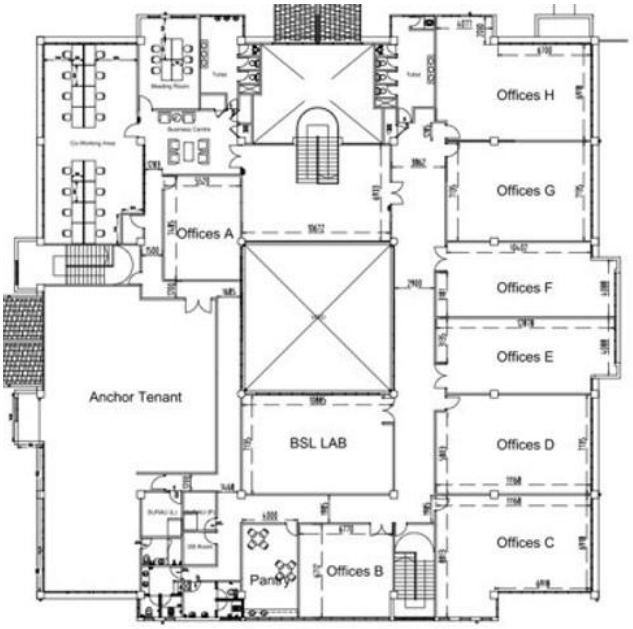
Incubating Ideas @ CREST Place



As CREST aims to continuously catalyse innovation while supporting entrepreneurs, we seek to facilitate as best as we can with the goal of supporting the ecosystem of large private companies in Malaysia. The most concrete of our testament to this commitment is CREST Place, a 10,000-sq foot space within the vicinity of CREST that houses a co-working space, private offices, an IoT Cloud Data Centre, meeting rooms and conference facilities that provide a hospitable, affordable and conducive environment for startups.

A joint initiative by the Northern Corridor implementation Authority (NCIA), University Science Malaysia (USM) and CREST, CREST Place is home to entrepreneurs and startup companies developing technologies and solutions for IC Design, IOT, Robotics, E-Commerce, Automation, Vision Systems and AR/VR.

In the last six years, CREST Place has hosted more than 30 companies in their formative years by providing a secure, easily accessible location for startups to meet and develop ideas and solutions. The companies who are tenants of CREST Place include Oppstar Technology Sdn Bhd, Linear DMS Solutions Sdn Bhd, Efinix Technology Sdn Bhd, Synvue Sdn Bhd and DR Automation & Robotics Sdn Bhd, to name a few.



News From the Community ~ Oppstar Technology

From humble beginnings

Oppstar Technology Sdn Bhd was founded at the time when Malaysia was looking for a homegrown company that designs integrated chips for semiconductors. In 2014, three friends who happen to be former colleagues from INTEL decided that the time was ripe to set up an IC design firm and the rest is history. Oppstar started from scratch and built up a track record in the market because although the founders were experienced (with a combined total of 77 years of experience), no one had heard of the company. It started with only two engineers and took on very low-level tasks. "There are seven to ten levels of IC design and Oppstar initially took on the easiest, which is layout artwork. The strategy was to assign engineers who could do so much more and once the client realised that the ones doing its layout artwork were capable of much more, it assigned more complex tasks. And this is how we grew." Ng Meng Thai, CEO of Oppstar said.Since the start of its operations, Oppstar has been housed in CREST Place, Penang. "We were looking for a space, equipped with everything we needed to run our business and we found it at CREST Place. Being housed in CREST Place allowed us the opportunity to bounce off ideas and collaborate with other companies involved in the similar space and this has benefited us tremendously." Ng said.

Co-Founders of Oppstar.
From left: Tan Chun Chiat, Cheah Hun Wah and Ng Meng Thai

OPPSTAR
Your Engineering Partner for Excellence

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Achieving Success

In a span of four years, Oppstar has achieved much success and is currently a one stop IC design firm that offers end to end services to local and international customers. “We have established partnerships with top semiconductor companies and key foundries to provide cutting edge technology node design solutions in ASIC and FPGA to our valued customers and currently, we have successfully delivered numerous complete projects for our clients, ranging from 55nm to 14nm deep sub-micron process technology nodes physical design and implementation.” Ng said.In its years of operation, Oppstar has already seen two “harvests”, or filings for IP. The company has gained considerable design experience in the 7nm process technology, the most advanced in the world and its engineers have the capability to work on state-of-the-art projects ranging from the latest mobile phone technology, IoT to technologies for autonomous vehicles. Its most recent success lies with its Artificial Intelligence (AI) team which has officially tapped out Malaysia’s first ever Artificial Intelligence Application Specific Integrated Circuit (ASIC) chip that acts as an edge device to accelerate AI Classification process.

Oppstar Technology Today

Oppstar has grown in leaps and bounds since its inception and to date prides itself as a one-stop IC design firm, offering end to end services to multinational companies in US, Europe, East Asia and Asia. The company has since expanded beyond its original 900sq-foot office at CREST Place, to accommodate a growing talent pool and to cater to demands from abroad.

Top: Oppstar's Startup Office @CREST Place

Left: Oppstar's team in front of I2U Building - home of their second office

Highlights - CREST Webinar

CREST spurs industry-government discussion on COVID- 19 impact on the E&E industry

CREST recently held its inaugural webinar titled 'Advantage in Adversity: The E&E industry in a post COVID-19 world' on 18 June 2020. Organised as an initiative to spur discussion and engage with the CREST community, the webinar also served as a platform to address issues concerning the E&E sector. Four of our board members made up the panelist for the session and they presented a balanced industry-government perspective on the impacts and key learnings from the pandemic in addition to measures that have been put in place to ensure recovery for the industry.

The panelist included Dr David Lacey from OSRAM, Eric Chan from INTEL and Tan Teong Khin from CLARION. Dato Azman Mahmud who is Chairman of CREST and CEO of MIDA was present to lend a balanced approach to the discussion through sharing of the initiatives undertaken by the government to assist the industry in weathering the pandemic.

During the session, the panelist spoke of the collaboration between industry and government in sharing knowledge and expertise, in addition to coming together to draw up standard operating procedures to ensure that safety measures are in place, prior to restarting the industry. This, among other factors, underpins the importance of industry-government collaboration for the betterment of the E&E sector.

Other topics discussed during the webinar include the importance of innovation in the era of the new normal and the need for local companies to step up their R&D efforts and innovate for long-term value.

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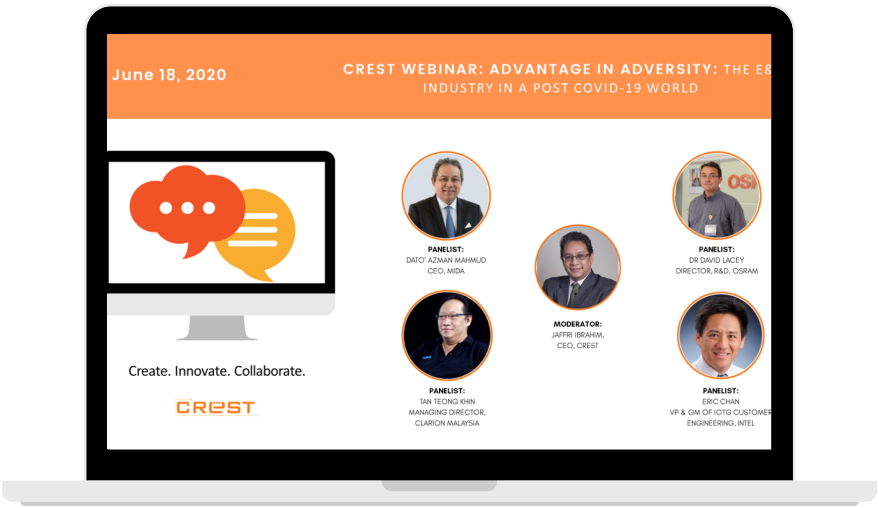
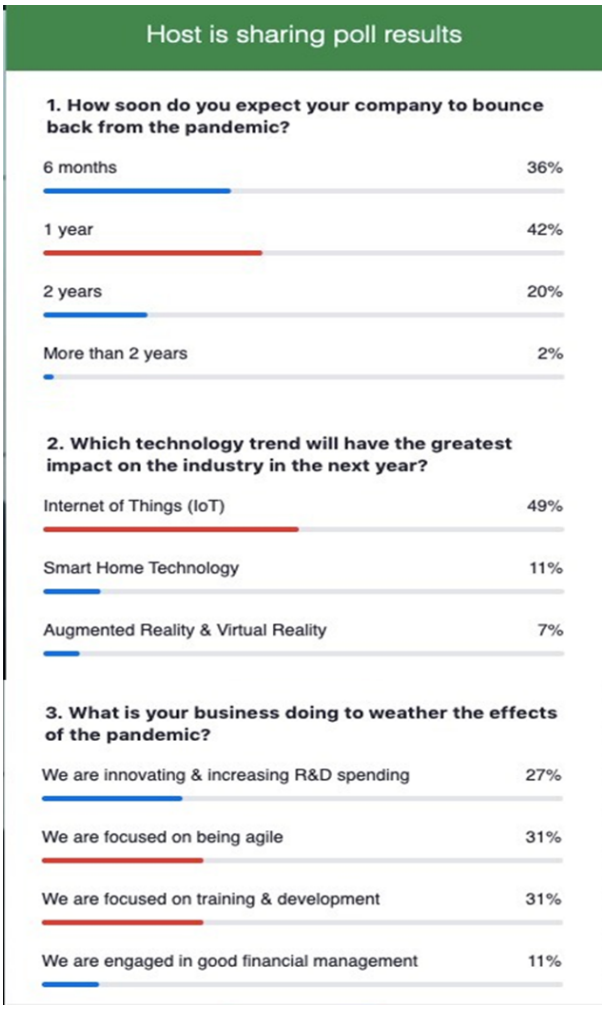
Highlights
- CREST Webinar

A copy of the webinar recording is available here: https://www.youtube.com/watch?v=2JXk6YDf1pw

We encourage you to listen to it to get more insights on the topics discussed. CREST will be organizing another session soon and we look forward to you joining us in our next webinar!

119
PARTICIPANTS





CREST co-sponsors COVID-19 virtual hackathon

CREST, together with Microsoft, Malaysia Digital Economy Corporation (MDEC) and Runcloud recently sponsored the 'Forkwell Coronavirus Hack', a virtual hackathon that aims to develop solutions for issues related to the COVID-19 pandemic.

Organised by Forkwell.io, the two-week hackathon kicked off on 30 March 2020 and gathered 493 software developers and data scientists and 17 domain experts in virology, bioinformatics, AI and big data from 32 different countries. The participants from all around the world created 412 teams and during the 14 day period, used a combination of AI, data analytics and machine learning to develop solutions that will assist Governments in combating COVID-19.

During the hackathon, participants were encouraged to curate and share solutions to diagnose and treat the virus.

They were able to make valuable contributions to developing a better understanding of the factors that impact the spread and measures to accelerate local preparedness and response efforts.

"There is a tremendous need for our collective ingenuity right now. Governments and healthcare systems are working endlessly towards finding solutions to the pandemic, to protect people and to save the economy. Through the hackathon, we have seen the emergence of many amazing solutions that Governments can implement to curb the spread of the virus and to save lives. CREST is proud to have played a part, through our sponsorship of the hackathon to make this possible" said Jaffri Ibrahim, CEO, CREST.

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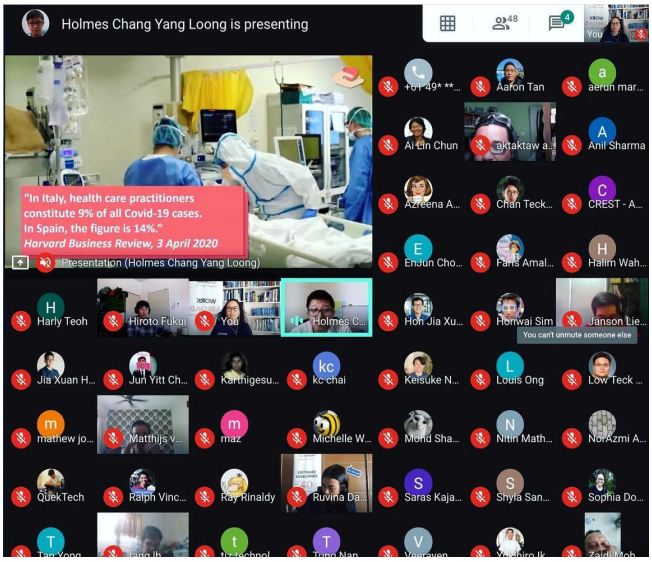
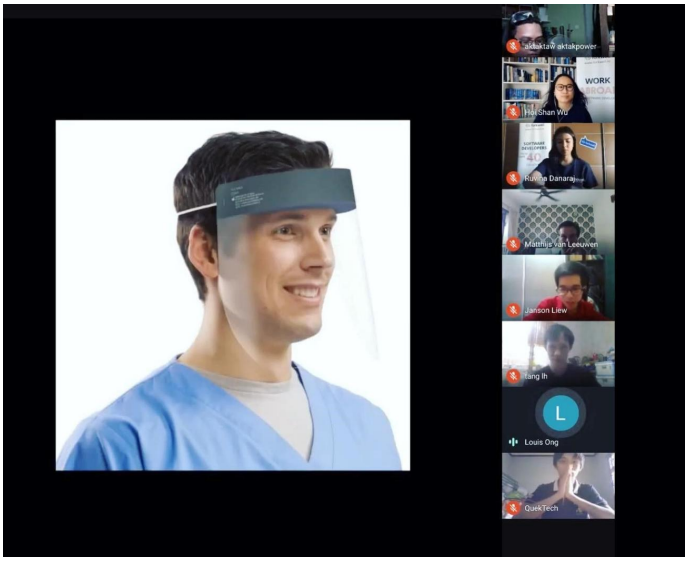
Highlights
- Forkwell Coronovirus Hack

The 'Forkwell Coronavirus Hack' received a total of 91 submissions, of which ten winners made it to the finals. Three teams were named overall champions and the findings, analysis and outcomes from the hackathon were shared by Forkwell.io with the Ministry of Health (MoH) to proliferate the pandemic combat, via avenues facilitated by MDEC.





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CREST Membership

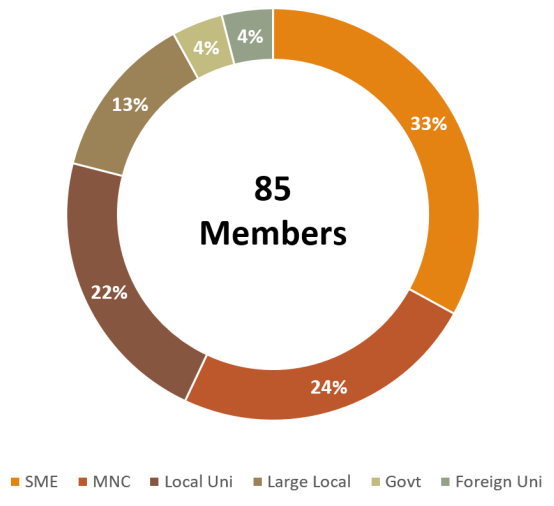
Become a Collaborator Today!

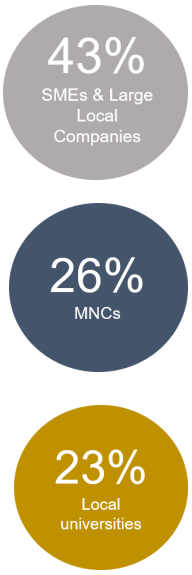
As a member-based platform, CREST members are the backbone of the collaborative platform. Member representation is the triple helix of government, industry and academia

VALUE PROPOSITION OF BEING A CREST MEMBER.

- Collaborate with a network of like-minded organisations to advance innovation and achieve common outcomes
- Access to a network of industry-ready talent
- Access to R&D insights and to a research expert alliance
- Access to real market needs / challenges faced by multiple verticals
- Collaborate and jointly create solutions for the ecosystem.

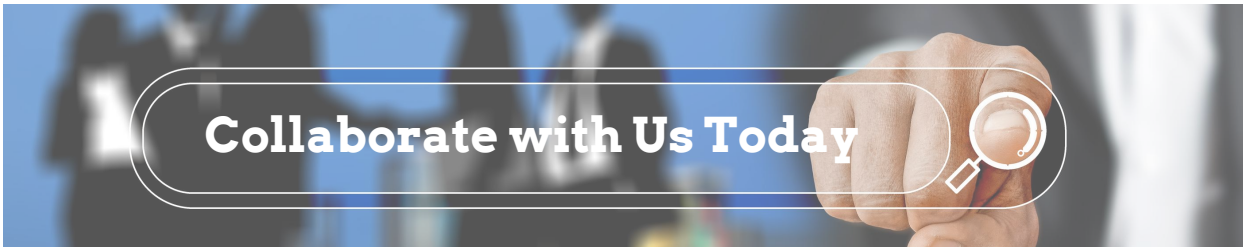
MEMBER PROFILE





for more details visit

www.crest.my/membership-outline



For more details on our programs and initiatives, feel free to contact our team below:

INITIATIVES	EMAIL
OPEN & TARGETED R&D GRANT	**Lim Poi Hong** **phlim@crest.my**
THE GREATLAB (TGL) PROGRAM - TGL YOUTH INDUSTRY BOOTCAMP - GRADUATE INNOVATION PROGRAM - INDUSTRY LEADERSHIP PROGRAM	**Haziati Abdul Hamid** **haziati@crest.my**
GALLIUM NITRIDE GAN RESEARCH PROGRAM	**Lim Hoo Kooi** **hklim@crest.my**
DIGITAL HEALTHCARE CLUSTER	**Aida Basri** **aida@crest.my**
INTELLIGENT & INNOVATIVE CITY CLUSTER	**Michelle Woo** **khwoo@crest.my**
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