Volume 4

SINGAPORE SEMICONDUCTOR VOICE

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EMBRACING THE MOBILITY TRANSFORMATION

SiC TECHNOLOGY DEVELOPMENT FOR POWER ELECTRONICS
AI-ENABLED ELECTRONICS INTEGRATED CIRCUIT DESIGN
EXCLUSIVE INTERVIEW WITH e2i CEO
WORKFORCE CHALLENGES FOR SME

SSIA
Singapore Semiconductor Industry Association

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FOREWORD BY EXECUTIVE DIRECTOR

2019 has been a challenging year for our industry as a result of the ongoing trade tension. I have been interviewed by several media organizations, and their questions have always been the same – is our industry facing the downturn seen in 2001 and 2009? The right answer is anybody's guess. However, we do see a difference in this downturn: Fabs are still receiving orders, not significant, but enough to keep the plant running. There is still a strong demand for semiconductor chips with pressure coming from technologies in the 5G arena.

We have also conducted a pulse survey with several semiconductor companies here in Singapore recently. Though most companies are not hiring, there are still some companies who are hiring backfill for critical positions. All these signs are showing that companies here in Singapore remain resilient towards this slowdown in business. The question we need to ask ourselves is, do we see the cup half-full or half-empty? We are starting to see companies stepping up to focus on improving the productivity of their operations and putting their staff through up-skilling courses. Therefore, when the economy picks up, these companies will be at the forefront to capture more business opportunities.

SSIA, through our mandate to drive the Electronics Industry Transformation Map (ITM), is committed to helping companies in the industry focus on productivity improvement, innovate their products and services, and most importantly, develop their workforce. In line with this, we have forward-looking events such as the SSIA Summit on 10 October 2019. This conference will cover topics on mobility, a key sector that will drive the semiconductor industry in the next 2 to 3 years. Companies, including SMEs, will learn how they can get into the mobility bandwagon, the technologies and trends that are driving the mobility sector, and start preparing their business to strive in this sector. Besides Summit, companies could participate in the upcoming Industrial Transformation ASIA-PACIFIC (ITAP) from 22 to 24 October 2019. ITAP is the leading trade event for Industry 4.0, and SSIA is proud to be a supporting partner of this event.

Having the right business strategy or the most advanced technology alone will not make a business successful. The key to business success is the people. We will need to invest in our workforce. SSIA has been working closely with WSG and e2i to help companies in talent recruitment, development and retention. We have launched initiatives to achieve this, and have been actively engaging the Human Resource teams from various MNCs and SMEs through platforms such as HR Roundtable and Human Resource Conference. Besides, we have recently started "Industry Relevant Courses", such as Operations Excellence, Cost Optimization and Semiconductor Fundamentals to help companies, especially SMEs, train their existing staff. Due to the overwhelming response from the industry, we have decided to have more runs of these courses.

Finally, I would like to end my foreword with a mention of this publication. This issue would be our 4th issue, and thanks to the support from the industry, we have been receiving plenty of support in the contribution of relevant content and sponsorship. We also see a growing demand for this publication, so we have decided to launch the magazine on more online platforms. I am proud to announce that The Semiconductor Voice is now on Magster and will soon be on other platforms such as Zinio, too. We are going global! Do reach out to us if you would like to support the publication.

Please check out SSIA website or reach out to us at secretariat@ssia.org.sg if you need more information with regards to the initiatives mentioned above. Thank you!

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INDUSTRY

PEOPLE

SEMICONDUCTOR INDUSTRY MEET 2019

5G TO BE A MAJOR REVENUE DRIVER FOR THE SEMICONDUCTOR

5G is the next generation of mobile network technology and is expected to be the new enabler for many market segments, including mobile phones, automotive, virtual reality, and IoT. This new technology is anticipated to be a major revenue driver for the semiconductor and electronics industry over the next few years.

Singapore Semiconductor Industry Association (SSIA) held its annual 'Singapore Semiconductor Industry Meet' at the Sheraton Towers on 23 July 2019. Previously known as the Members Meet, the event this year was opened to all members of the semiconductor industry with distinguished speakers sharing how 5G can drive productivity and innovation in the sector and how companies can leverage the emerging technology for business growth.

The event received overwhelming response, with around 170 industry leaders from 80 companies attended the event, and the attendance rate is three times that of last year. Speakers of the event included industry experts on 5G, such as Dr. Carlos Mazure, Chairman & Executive Director of the SOI Industry Consortium, and Mr. Gobinath Vanan of National Instruments ASEAN & ANZ, who talked about the growth for 5G technologies and challenges to be overcome.

Mr. Ang Wee Seng, Executive Director, SSIA, said in his opening speech, "We have noticed the impact of the US-China trade war is felt across the globe. The semiconductor industry here and in the region is not spared. Despite this, the industry is not slowing down in driving initiatives such as 5G technology to unlock business opportunities. Besides, SSIA has been launching different workforce development strategies which will help develop the talent pool for the ongoing industry transformation as well as the next economic upturn."

Under the workforce development initiatives, SSIA has been giving talks at secondary schools to bring awareness of our industry not only to young students but also their parents and teachers. Besides attracting new talents, SSIA has conducted relevant courses such as the Operations Excellence Course and Singapore Semiconductor Leadership Accelerator Program for the industry

Dr. Carlos Mazure, Chairman & Executive Director of ***SOI Industry Consortium***

Gobinath Tamil Vanan, Field Marketing Manager of ***National Instructments ASEAN & ANZ***

Neelesh Maglani, Strategic Pursuits Lead & Chief Technologist of ***HP Enterprises***

Glenn Vandevoorde, Chief Executive Officer of ***arQana Technologies***

Pankaj Gulati, Head – International Growth of ***Starry Inc.***

Mr Ang Wee Seng, Executive Director of ***SSIA***

peers. In line with the direction to focus on workforce development, SSIA will be announcing more initiatives in the coming months.

" We should see the glass half full in the light of the current business downturn and take it as an opportunity to prepare ourselves for the upturn. We are glad to see recorded attendance from our latest events showing that our peers strive to focus on innovating their products and service offerings amidst the challenging environment. SSIA will organize more activities and initiatives which are in line with the Industrial Transformation Map (ITM) together with our industry partners and government agencies," said Mr. Ang.

Networking session at the event

SSIA SIGNED MOUs WITH SUTD AND NUS

SSIA signing MOU with SUTD

Singapore Semiconductor Industry Association (SSIA) signed two Memoranda of Understanding (MoU) on 24th July 2019 with Singapore University of Technology and Design (SUTD) and the National University of Singapore's School of Continuing And Lifelong Education (NUS-SCALE) respectively to strengthen its collaboration with the two universities.

Develop World's 1ST AI-Driven IC Design Internet Platform With SUTD

The first MoU signing with SUTD took place in the morning at SUTD's annual Fostering Industrial Research Success Together (FIRST) Industry Workshop, where stakeholders from industry, academia and the Government convened to foster collaborative research and deepen industry-academia ties. The MoU was signed by Prof. Yeo Kiat Seng, Associate Provost of Research & International Relations, SUTD and Mr. Ang Wee Seng, Executive Director of SSIA. Under the MoU, SUTD and SSIA will jointly work towards the research and development of the world's first AI-driven Integrated Circuit (IC) design internet platform where existing Intellectual Property (IP) can be shared and traded, new IPs can be jointly created and optimised as well as new products and applications can be produced more reliably, cheaply and quickly. This partnership will also allow for another world-first endeavour - the use of Blockchain technology to protect the usage of semiconductor IPs.

"This collaborative research will build on SUTD's research expertise and SSIA's industry know-how as we strive to devise the world's first AI-driven Integrated circuit design internet platform. The rich technological exchange will fuel the development of such innovative technologies to stay ahead of industry transformation and enable our leap towards greater connectivity, speed and capacity," said Professor Yeo Kiat Seng, SUTD Associate Provost for Research and International Relations.

SSIA signing MOU with NUS-SCALE

Collaborate With NUS On Talent Development Projects

The second signing of MoU took place at NUS Museum in the afternoon. It was signed by Prof. Wei Kwok Kee, Dean of NUS SCALE and Mr. Ang Wee Seng. The MoU coverage is focused on promoting thought leadership in lifelong learning and talent development for semiconductor industry professionals. NUS and SSIA will collaborate on initiatives and projects that will enable semiconductor industry professionals to stay relevant with the right knowledge and skills.

Said Professor Wei Kwok Kee, Dean, NUS SCALE: "In a world where technological disruption is now the norm, our workforce has to embrace lifelong learning to remain relevant and competitive.

As a champion of continuous and lifelong learning, we are ready to help prepare businesses for Industry 4.0 through our contemporary and engaging education and training programmes. Thus, we are proud to partner the SSIA to enhance the capabilities of Singapore's semiconductor industry, and propel it into the future with confidence."

Commenting on the two collaborations, Mr. Ang Wee Seng, SSIA Executive Director, said, "While the semiconductor industry in Singapore and the region is facing the recent economic challenge as well as the transformation of industry 4.0, innovation and talent will be the two key pillars to grow the industry. Signing MoUs with the two universities will enable us to help our peers embrace innovations and develop the right talents for the future."

SSIA HR CONFERENCE FOR SMALL MEDIUM ENTERPRISE

SSIA conducted the first SME HR Conference on 28 August 2019. This platform was created to focus on helping local SMEs address human resource challenges. During the opening address of Mr Ang Wee Seng, Executive Director of SSIA, he highlighted the result from a survey conducted earlier this year that companies were looking at talent development and retention as top 3 business challenges in the near future.

HR Conference for SMEs

With the market downturn due to the trade tension and all other external factors, we need to look at opportunities to develop and up-skill our current workforce. This point was stressed by SkillsFuture SG, who also presented initiatives that will help companies develop their workforce

Employment & Employability Institute (e2i) presented initiatives for companies going into digitalization, while NTUC showcased their membership benefits. NUS School of Continuing and Lifelong Education - SCALE also presented their courses that can be customized to support the needs of the local companies to develop their workforce. SSIA would like to thank the 15 companies who attended the HRC, and hopefully they have benefited from the sharing.

Ang Wee Seng, Executive Director of SSIA

Karen Tan, Principal Specialist, Electronics & Transport Engineering, e2i

FIRST SSIA EHS WORKGROUP

SSIA held the first EHS Workgroup meeting on 27 August 2019. 15 companies participated in this first meet. There have been calls for SSIA to be a neutral platform to represent the semiconductor companies on the EHS front. Like many workgroups SSIA has formed this year, EHS workgroup serves the objectives of being a bridge between the various agencies and the industry; as a voice for the industry on engaging agencies in developing policies, and a body to help coordinate and organize common EHS activities and events, e.g. workgroup meetings and EHS training.

NEA was also present to get feedback on EMIS grant. This is a grant that will support the company financially in installing energy monitoring systems. The scheme will be rolled out later this year.

The meeting ended with a nice networking session and participants enjoyed great catching up with old friends!

Write to us at secretariat@ssia.org.sg if your company is keen to participate in the HR Conference or EHS Workgroup in the future.

EHS Workgroup

Brent Liu, Senior Engineer, NEA

Networking after the EHS Workgroup

(Centre) Chief Artillery Officer, COL Michael Ma in a group photograph with employers

SSIA JOINED THE EMPLOYERS VISIT TO HIMARS BATTERY ON IN-CAMP-TRAINING

The Singapore Artillery, the oldest arm in the Singapore Army, can trace its beginnings to the Singapore Volunteer Artillery formed in 1888. This interesting nugget of history was shared with more than 90 employers who visited the Singapore Artillery on 1 Aug 2019, co-hosted by the Artillery Institute (AI) and the National Service Directorate (NSD). It was organised to give employers a better understanding of the capabilities of the Artillery formation and an appreciation of how our Operational Ready National Servicemen (NSmen) are trained during their annual In-Camp Training (ICT). SSIA was one of the associations invited to this visit.

In his welcome address, Commander Artillery Institute, Senior Lieutenant Colonel (SLTC) Vincent Koh reiterated the important role that employers play in supporting their NSman employees. During the visit, Chief Artillery Officer, Colonel (COL) Michael Ma, thanked employers for taking time out from their busy schedules to better understand National Service and the training that their NSman employees go through.

Employers were introduced to various Artillery platforms such as the 155mm Field Howitzer (FH2000), ARTHUR Weapon Locating Radar, Field Artillery Meteorological System and the BELREX Protected Combat Support Vehicle. The employers were also excited to try out some of these platforms on simulators such as the Artillery Detachment Trainer (ADT) and the Call-For-Fire Simulator (CFFS).

Employers observing a demonstration of loading drills at the Artillery Detachment Trainer (ADT)

In his address to the employers, the Battery Commander (BC), CPT(NS) Tiong Jia Ming reiterated the importance of NSmen returning for ICT annually to hone their proficiencies and strengthen team integration so that they can remain operationally ready as a unit. He expressed appreciation to all the employers and their co-workers for making the necessary arrangements so as to allow NSmen to serve their nation with peace of mind

Since the launch in Aug 2016, many employers have come on board the NS Mark Accreditation Scheme to demonstrate their support for National Service and Total Defence. Companies may apply online via www.NSmark.sg or email them for more details at NSOutreach_NSD@defence.gov.sg. There is also a LinkedIn page for NS Advocates under "Your Support Matters" to allow more employers to be inspired and empowered to emulate support for NS.

Commander Artillery Institute, SLTC Vincent Koh answering queries on ARTHUR Weapon Locating Radar at the static display of Artillery platforms

HETEROGENEOUS PACKAGING, SiP AND RELATED TECHNOLOGIES AND FUTURE CHALLENGES

Heterogeneous packaging is a natural outgrowth of hybrid and multi-chip packaging technologies which have developed to enable 5G telecommunication, autonomous vehicles, and Internet of Things (IoT) applications. Newly developed processes such as high-density interconnect substrates, Through Silicon Vias (TSVs), Fan-Out Wafer Level Packaging (FOWLP), integrated passives, and embedded antennas have made the promises of heterogeneous packaging, or System-in-a-Package (SiP), a reality.

The course Heterogeneous Packaging, SiP and Related Technologies and Future Challenges held on 16-17 September 2019 has covered the recent technological developments that have empowered heterogeneous packaging to give the participating engineers a working knowledge that can be quickly applied. The class has also provided tools to enable each participant bringing products to market faster. Besides process technologies, the class has also given insights into the thermomechanical, thermal, and electrical behavior of TSVs/FOWLPs and their reliability. It also showed examples of TSV and FOWLP devices currently available in the marketplace and discussed future applications to mixed technology devices. The course has also presented the current heterogeneous roadmap being developed under the auspices of the IEEE Electronics Packaging Society.

FAILURE ANALYSIS AND RELIABILITY CHALLENGES FOR ADVANCED SEMICONDUCTOR TECHNOLOGIES

Electronics are continuously growing more intricate and are being integrated into ever more mission-critical applications such as autonomous vehicles, avionics, and implantable devices that sustain patients' lives. Failure of any electronic device in these applications can cost millions of dollars, and even result in loss of life. Even in devices where failures are not life-threatening, customers' expectations place stringent demands on product requirements.

During the course Failure Analysis and Reliability Challenges for Advanced Semiconductor Technologies held on 19-20 September 2019, Mr Darvin Edwards, the course lecturer, introduced to engineers from different disciplines the fundamental package failure modes and mechanisms that lead to product failures. With knowledge of failure mechanisms and a good understanding of the contributing factors, students have been taught to design out failures, leading to first-pass product success. The training has also shown multiple examples of failure mechanisms and solutions taken from traditional and new package styles such as FC-BGAs, WCSPs, and the newest fan-out and through silicon via technologies. Throughout, the emphasis was put on using this information to eliminate future problems.

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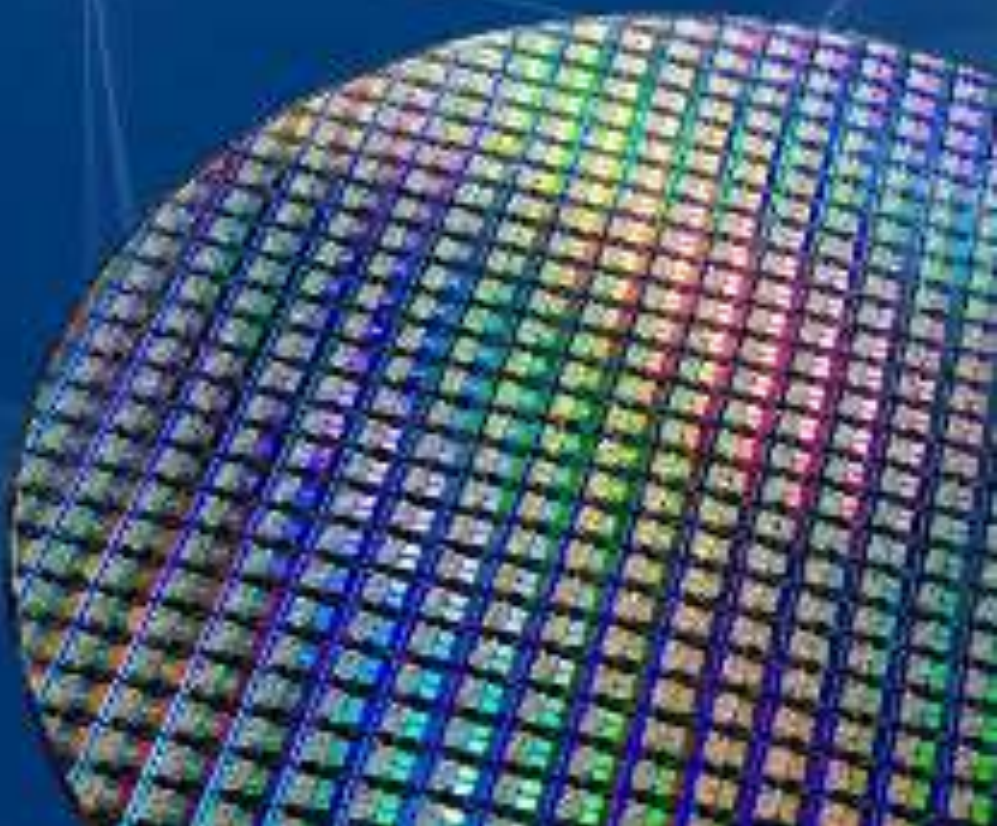

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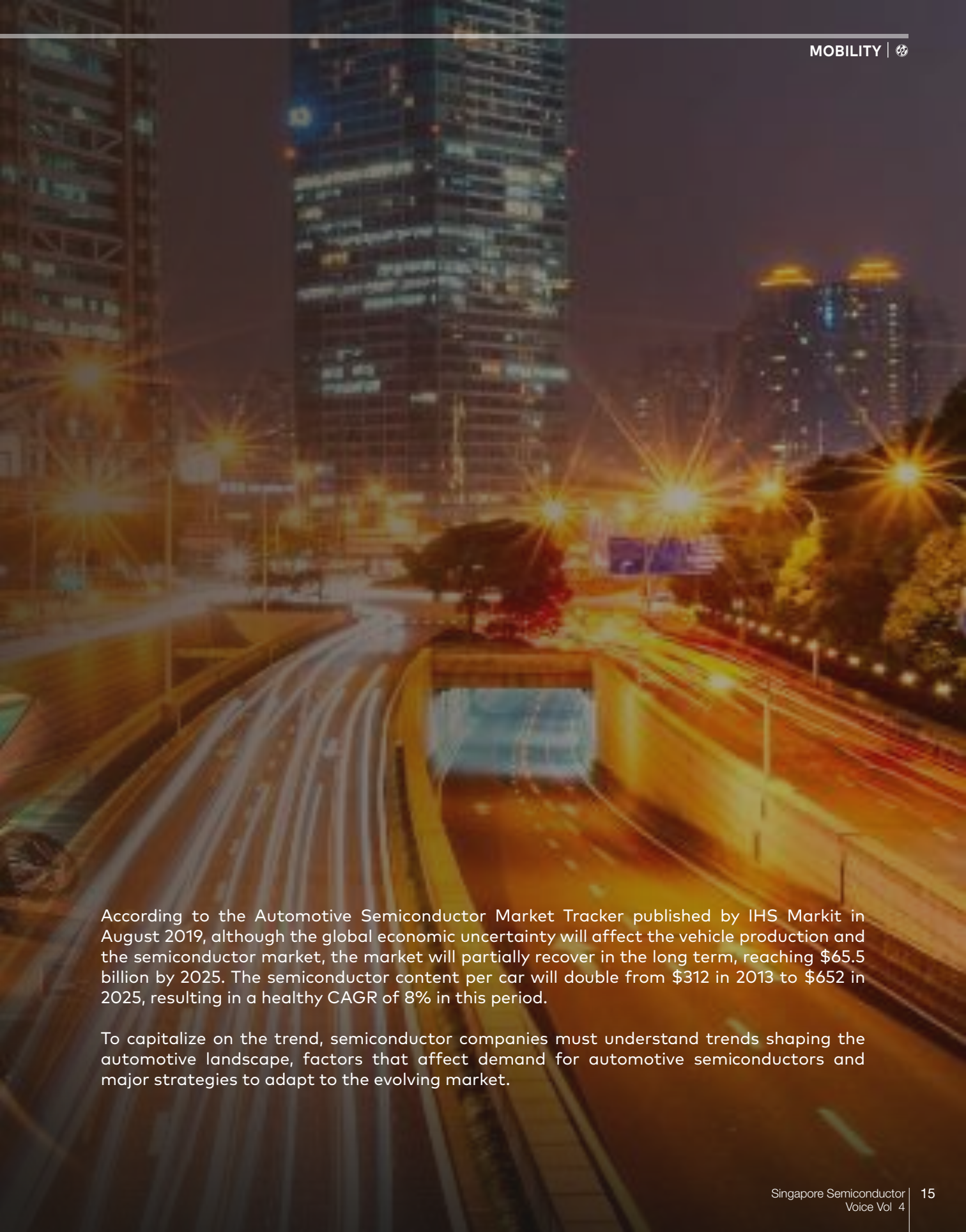
AUTOMOTIVE SEMICONDUCTORS IN MOBILITY TREND

New mobility trends are diversifying the demand for automotive semiconductors. The consistent growth of the global automotive semiconductor market can be attributed to various factors such as growing safety, security and convenience needs, increasing demand from emerging economies, high production volumes of autonomous vehicles, and a rising trend of vehicle electrification.



According to the Automotive Semiconductor Market Tracker published by IHS Markit in August 2019, although the global economic uncertainty will affect the vehicle production and the semiconductor market, the market will partially recover in the long term, reaching $65.5 billion by 2025. The semiconductor content per car will double from $312 in 2013 to $652 in 2025, resulting in a healthy CAGR of 8% in this period.

To capitalize on the trend, semiconductor companies must understand trends shaping the automotive landscape, factors that affect demand for automotive semiconductors and major strategies to adapt to the evolving market.

EMBRACING THE AUTOMOTIVE TRANSFORMATION

The automotive semiconductor market is going to be a key driver for our industry in the next 3 to 4 years. Market studies have estimated the automotive semiconductor market will worth close to USD50 billion by 2022, almost double the value from half a decade before. This growth is fuelled by advancement in technologies such as 5G, artificial intelligence, electric vehicles and autonomous vehicles. It is no surprise that the automotive sector is the fastest-growing market, overtaking computers and communications sector, according to IC Insights. We will soon be seeing our dreams of fully autonomous vehicles coming to reality in this lifetime.

Zero Defects Mentality

However, getting into the automotive semiconductor business isn't as easy as one might imagine. Automotive parts require far more stringent quality control. Every part that goes into a vehicle, especially chips that directly impact the vehicle core system, can impose a risk to human life. Manufacturers will need to meet particular industry quality standards throughout the manufacturing and testing process. Automotive manufacturers and suppliers are demanding parts per billion levels of

automotive quality, and Fabs are all in pursuit of Zero Defects. Zero Defects is the comprehensive automotive quality control which is not just a system or solution any Fab can put in place to achieve. Zero Defects can only be achieved by a paradigm shift in quality mindset and a pursuit for continuous improvement mindset by every staff in the company. It needs to be built into the core values of the business and starts with the company's leadership.

Fabs now realize that Zero Defects is not only a prerequisite to get into the automotive business, but also a quality stamp of approval that the Fab has achieved automotive-grade Zero Defects quality control. This change has a profound quality impact on every other part running in the Fab. There will also be an improvement in product and line yield of every part running in the Fab, such as fewer scraps and fewer customer returns. In all, growth in business. Even suppliers of equipment and materials will need to embrace the transformation to move towards Zero Defects mentality. That means the entire industry will need to move together towards automotive quality excellence. Automotive quality standards will soon be the minimum standards required in all Fabs.

The Ongoing Transformation

This transformation is not just for the big companies, but the small and medium enterprises (SME) will need to transform as well to get into the automotive business. However, it is not so simple for SME to transform if they do not know the requirements for automotive parts. There is a need to establish a platform to engage the SMEs, and to ensure they are part of the industry transformation to embrace the automotive quality requirements, too. The SSIA Summit can be one such neutral platform to communicate this expectation to the SMEs, and to engage them also.

The automotive semiconductor market is enormous, and it will continue to grow year on year. We will need many companies to join the bandwagon to expedite the realization of our dreams of fully autonomous vehicles. Embracing the automotive transformation will grow our semiconductor industry.

ABOUT THE AUTHOR

Ang Wee Seng
Executive Director, SSIA

Wee Seng has close to two decades of experience in the semiconductor industry including Fab startup, process integration, technology development, yield improvement, manufacturing and equipment engineering. He was also involved in leading the automotive manufacturing transformation in one of the most advance 12" fab in Singapore.

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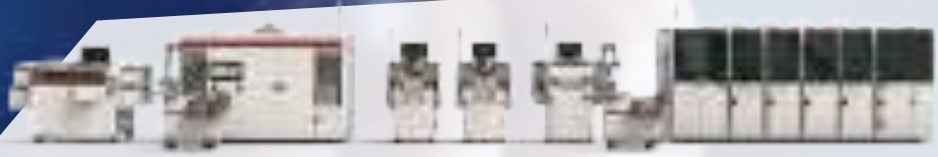

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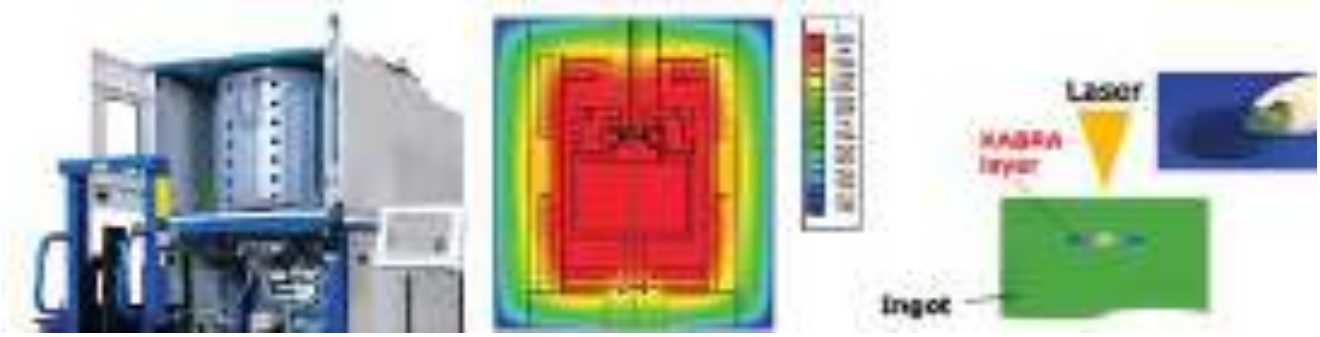
SiC TECHNOLOGY DEVELOPMENT FOR POWER ELECTRONICS

Urban mobility is evolving to incorporate electrification of transport as the main pillar for efficient handling of energy resources. In order to reduce carbon dioxide emissions, electro-mobility has been deployed as a possible area for vehicle technology development incorporating electric powertrains and advanced connectivity toward autonomous driving. The success of electro-mobility is dependent on power electronics solutions which must be efficient enough to influence less cooling on the battery management, thus making components smaller and lighter. Currently, silicon carbide (SiC) is considered as a better semiconductor for high power electronics as compared to silicon, and the 4H-SiC polytype offers a higher breakdown electric field, higher thermal conductivity, higher saturated electron drift velocity, and lower intrinsic carrier concentration. The research program at the Agency for Science, Technology, and Research (A*STAR) aims to grow high crystalline quality 150 and 200 mm diameter 4H-SiC, where the optimization of growth processes focuses on reduction of defects in both bulk and epitaxial wafers. Additionally, the program aims to attract current semiconductor industry players as partners toward development of SiC electronics and training of manpower to benefit a budding SiC industry ecosystem in Singapore.

Bulk Crystal Growth of SiC

The most popular method for the bulk crystal growth of SiC is the physical vapor transport (PVT) technique. For the development of 4H-SiC substrates with a low defect density, the project at A*STAR Institute of Materials Research and Engineering implements a modified-PVT (MPVT) technique with a growth temperature in the range between 2100 to 2400 °C. The approach aims to showcase 80% device production yield and to achieve the cost reduction target of <$ 1000 for SiC wafers. The preparation of epiready wafers from bulk SiC is more challenging than Si, as ingot slicing, grinding and polishing requires specialized tools. DISCO has recently developed a KABRA (Key Amorphous-Black Repetitive Absorption) slicing process that is based on an irradiating laser beam vertically from the upper surface of the ingot. This continuously excited beam enables peeling and formation of wafers. This is one of the examples implemented for the preparation of 4H-SiC epiready wafers for power electronic applications.

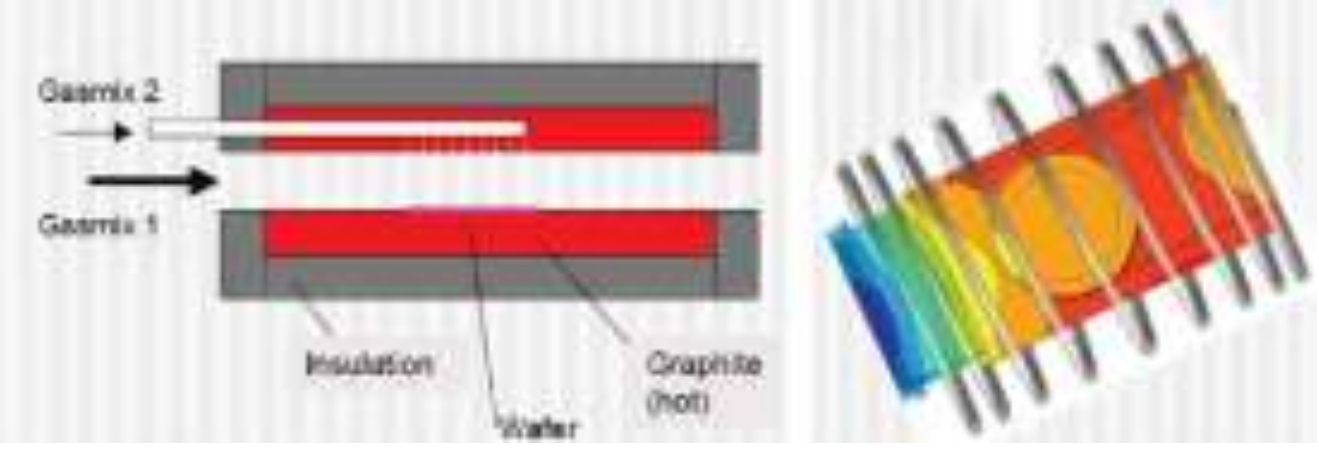


(a) (b) (c)

Figure 1. (a) A PVT tool for bulk crystal growth of SiC; (b) temperature distribution in a PVT reactor by STR computation model, and (c) DISCO's KABRA ingot slicing process for SiC substrate preparation.

Epitaxial Growth of SiC Layers

The epitaxial growth of SiC is addressed by the high-temperature chemical vapor deposition (HTCVD) techniques. The project implements hotwall HTCVD with a temperature range of 1500 – 1700 oC, where the growth in the reactor can be performed using classical precursors such as trichlorosilane ($HSiCl_3$), propane (C3H8) or ethylene (C2H4). Due to flexibility of reactor design, high growth rate can be achieved by chloride based growth process to enhance the adatoms mobility on the growing surface. In terms of production cost and reproducibility for industry, high growth rate seems to be beneficial with lower energy consumption, faster heat up time, and reduction of hydrogen consumption as a carrier gas. Apart from removing surface defects during the epitaxial process, efforts are focused on the reduction of the surface roughness for layers to be grown on 4H-SiC wafers. A wide variety of structural and optical characterization tools are used to study various defects formed during epitaxial growth.



(a) (b)

Figure 2. (a) HTCVD reactor concept for growth of 4H-SiC epilayers with gas flow and (b) hotwall CVD design.

Defects Analytics of SiC

The main challenges for large wafer area SiC development are related to defects present in the epitaxial layers and bulk substrates. Defects such as micropipes, dislocations, and inclusions have to be minimized for high volume production of SiC-based metal oxide semiconductor field effect transistors (MOSFETs). Micropipes are described as hollow coreless tubes extending along the c-axis of 4H-SiC and exhibit characteristic morphological features as "large dark pits". The most common line defects are threading screw dislocations (TSDs) and threading edge dislocation (TEDs), often exhibiting characteristic morphological features as "shallow pits". The inclusions can be acute triangular or needle-like shaped features extending along the off-cut direction. Structural inhomogeneity and imperfections are also seen in SiC due to Al p-type implantation into 4H-SiC. In the project, four broad categories are used for defect inspection such as *optical microscopy, photoluminescence, x-ray diffraction-topography, and electron microscopy*. The other issues hindering the market growth of SiC MOSFETs which will be addressed during the course of the program such as: (i) long-term reliability due to gate oxide/SiC interface defects and traps, (ii) device cost, and (iii) integration issues (e.g. gate drivers).

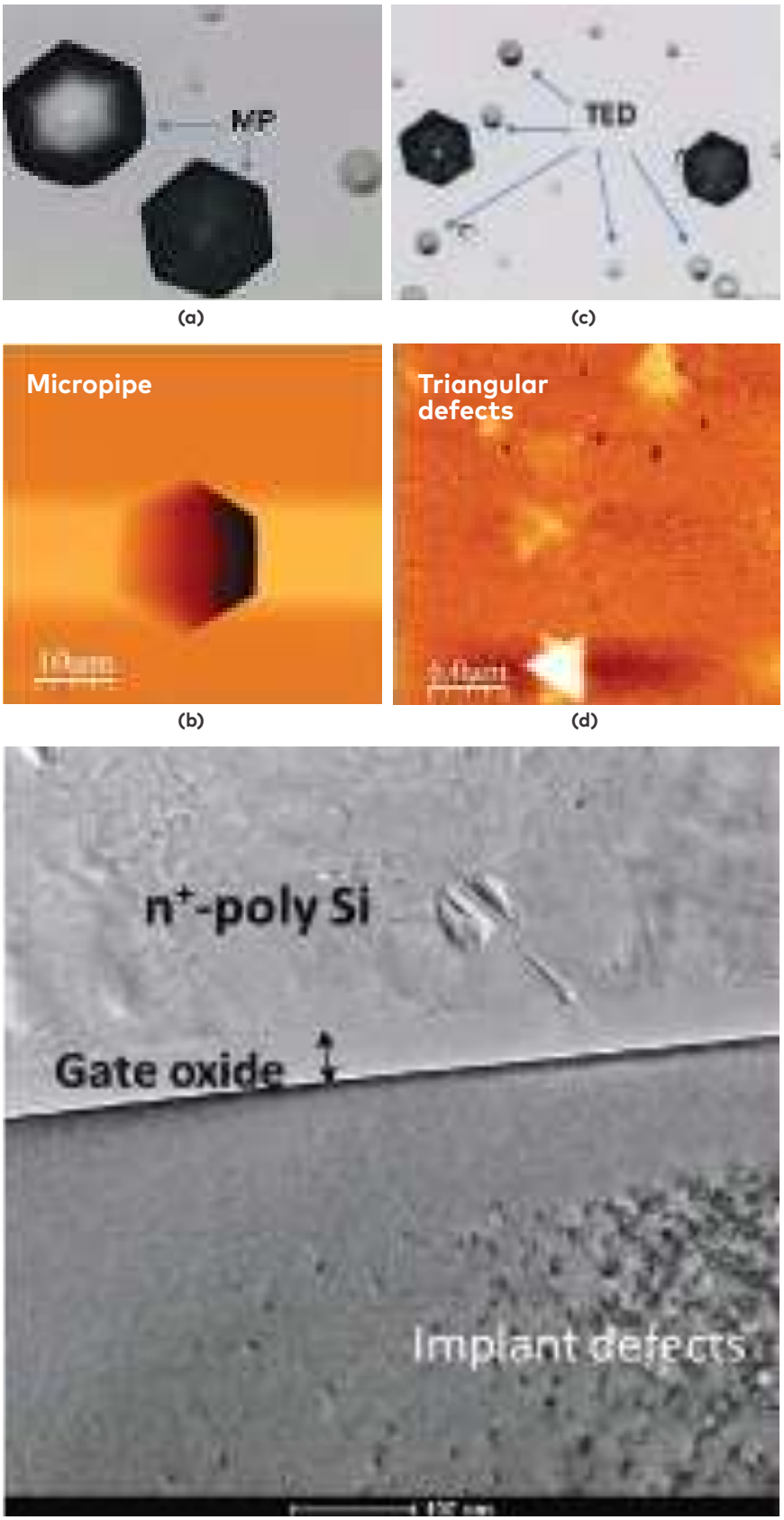


Figure 3. *(a) and (b) show optical and AFM imaging of Micropipes in 4H-SiC wafers, (c) TEDs in 4H-SiC, (d) triangular defects by AFM, and (e) Bright field TEM of SiO2 gate oxide/SiC interface and Al-implant damage in layers.*

SiC Industry Outlook

The primary metrics to judge the SiC solutions in urban mobility may include the potential to accelerate the adoption of SiC in electrification of automotive, renewables, and other power conversion modules. As the majority of Singapore-based foundries (e.g. ST-micro, Infineon, Globalfoundries) are developing front-end 200 mm power device integration processes, this project takes the precedent step to develop 200 mm SiC epitaxial wafers for adoption in electro-mobility. As shown in Fig. 4, the project addresses 'Issue 1', which is the most critical component of SiC industry value chain, while other issues related to system level integration would be addressed by players switching to production of SiC power modules to displace the currently used, but inefficient Si IGBTs. Industry roadmaps show that SiC device market is expected to grow rapidly due to mass deployment projections in electric vehicles. SiC-based inverters can also reduce the installation costs for a PV inverter by 40 % due to a lower overall weight and a higher power density. Another upcoming SiC power module introduction will be in traction and in trains within next 3 to 4 years. In addition, renewable firming, where renewable power is used to charge the batteries, will open up new market growth for SiC technologies.

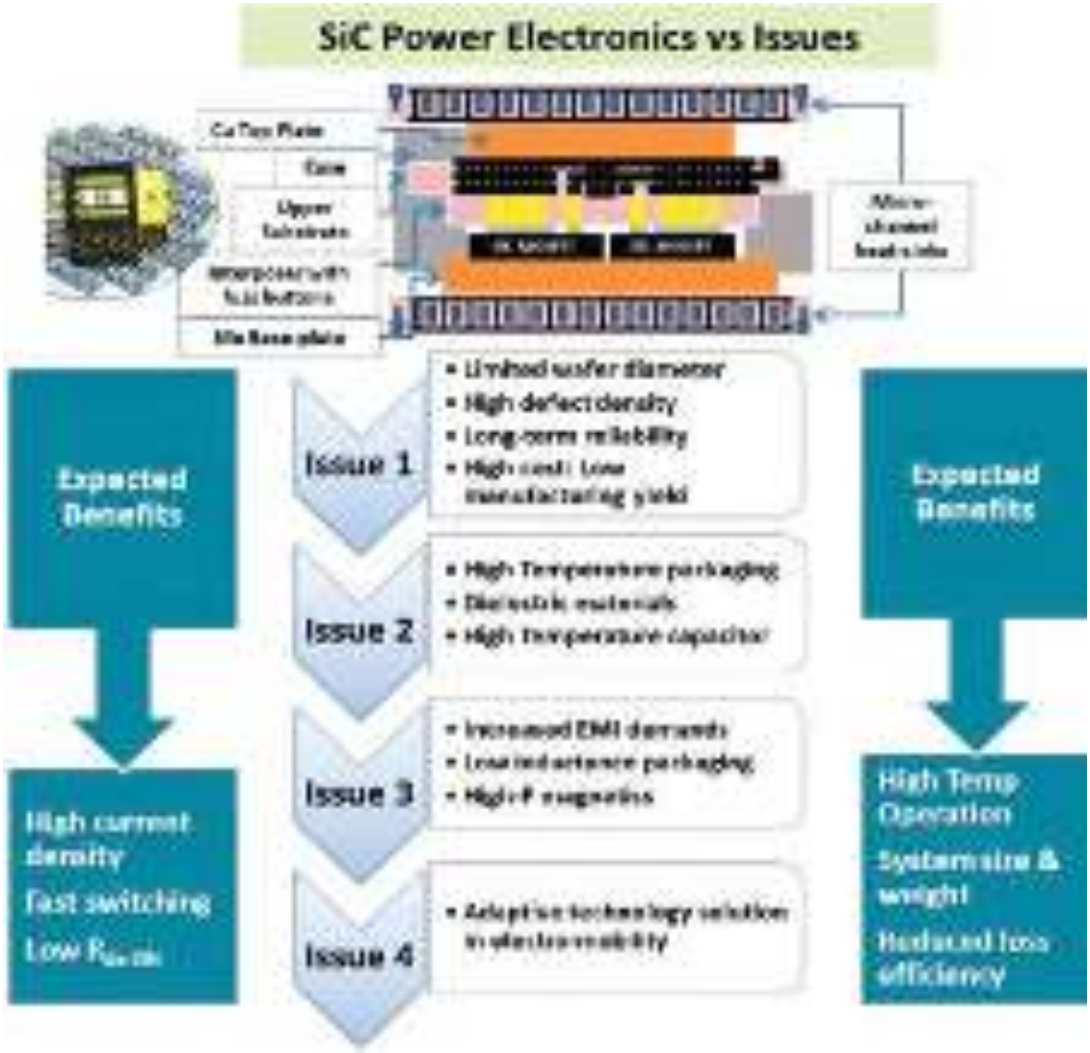


*Figure 4. Issues related to SiC-based technology adoption: the project addresses Issue 1 through the development of 200 mm 4H-SiC platform. The A*STAR research units also plan to develop integration solutions with local semiconductor ecosystem for the deployment of SiC electronics.*

Source of contents:

Surani Bin Dolmanan, Anna Marie Yong, Janaki Shanmugam, Siew Lang Teo, and Sudhiranjan Tripathy, A*STAR Institute of Materials Research and Engineering of Singapore

Please contact us to learn more: industry@imre.a-star.edu.sg

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BATTERIES FOR MOBILITY AND BEYOND

Introduction

Batteries are a key technology for the future of mobility. With many countries pledging to stop selling fossil fuel vehicles within 20-30 years, battery tech will continue to grow in its importance. New and improved battery tech will have a range of mobility applications including personal mobility devices, electric motorcycles, cars, trucks, buses, marine and even flight. Beyond mobility, small IOT devices will have integrated batteries 'grown' next to the IC or 3D printed into bulk objects. Personal gadgets will remain as thin as ever, but will last days on a charge and battery based energy storage for micro and macro grid applications will become ubiquitous.

There is a rising tide in the battery space. Boats will be lifted up, but with leaps and bounds to be made in the technology, industry players won't just be lifted up, but boats will be bigger, sail faster and longer on a single charge while having lower net emissions.

The Battery Industry: IMRE, Singapore and Beyond

Batteries and semiconductor are different technologies, but upon careful examination, similarities can be found in the two industries.

The key to semiconductors is the Integrated Circuit chip and the growth that Moore's Law suggested. Entire support industries have been built to enable this growth: raw materials become refined materials, tool manufacturers continually push the limits of precision engineering and IC packaging is becoming ever more efficient and ever evolving use cases continually expand the market.

Figure 1: Basic battery supply chain

In the battery space, the key technology is the battery cell and how to get the best performance out of it in terms of capacity, charging rate, discharging rate and long term stability. Raw materials are chosen for their performance and then continually reformulated for optimum performance. Battery cells are manufactured as the most basic unit for energy storage. Cells are bundled together into battery packs which are then assembled into battery modules, often with the inclusion of cooling solutions and performance driven battery

management systems.

At the Institute of Materials Research and Engineering (IMRE) within A*STAR, the majority of our battery work is looking at new active materials to improve battery performance at the cell level. This includes high capacity anode materials, for example, silicon-based anodes and more-stable high rate anodes such as modified lithium titanate (also known as lithium titanium oxide, or LTO). The goal is to enable the individual battery cell to store more energy per unit mass (high energy density) or deliver higher current (high power density) with the possibility of safe fast-charging functions.

For example, we are developing a new Li-ion cell that is cooler under fast charging. In the figure below, we can see that under the same charging conditions, after 15 minutes to reach a full charge, the IMRE battery is much cooler than commercially available batteries. Advances like this will help improve battery safety and while allowing for increased performance and expanded use cases.

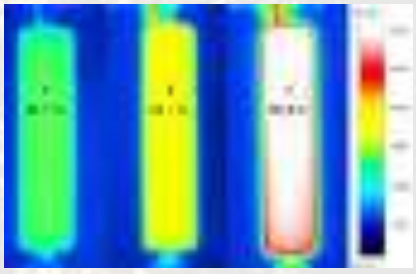

Figure 2: Temperature of 18650 Li-Ion cells under fast charging. Left: IMRE cell in development, Middle: Commercial High-Power Cell, Right: Commercial All-Purpose Cell.

Cell manufacturers and active material suppliers are continually making improvements in the capacity for both anode and cathode materials. At IMRE, we focus more on concept innovation to explore new approaches which could improve the stability of these high-capacity and high-rate materials. This is crucial for practical applications but not always straightforward.

Once battery cells are manufactured, they are often immediately assembled and wired together into battery modules. This could be akin to IC packaging. In this step, providing a safe operating environment for the battery cell is key. Proper selection of materials for connectivity between cells and thermal management is important.

The final form of modern, advanced batteries is the battery pack. This is a number of battery modules assembled together, along with a battery management system for active control. Sometimes this includes an active temperature management system as well. Some applications may just have a single battery module in a pack while others, such as automotive will have hundreds.

The brain of the battery is the battery management system. It is responsible for the overall system performance. This can be as simple as monitoring the rate of charging and capacity to ensure the module doesn't overheat and catch fire. Or, it can be as sophisticated as different use cases over the battery lifetime, even potentially using AI chips to learn the specific cycles of the individual unit and adapting the allowable conditions for either high performance, endurance or somewhere between.

Eventually, batteries reach the end of their lifetime. For high-performance batteries that may no longer be sufficient for the original use case, they can be repurposed for less demanding applications, such as reusing EV batteries for Grid applications. For batteries that cannot be repurposed, or those that have already reached the end of their second or third lives, they need to be properly disposed of or recycled. The careful separation of the performance materials will be key, just like in waste electronics.

The battery industry in Singapore is small and growing with many opportunities. Innovation opportunities for better battery performance are available throughout the supply chain. Come talk with us to explore what we can do to grow together.

A primer on batteries / list of definitions :

- **Battery Materials:** Most high performance batteries are commonly known as Lithium Ion batteries. However, there are several different types, each with distinct characteristic. Some common cathode materials are: NMC (Lithium Nickel Manganese Cobalt Oxide), NCA (Lithium Nickel Cobalt Aluminium Oxide), LCO (Lithium Cobalt Oxide), LMO (Lithium Manganese Oxide) and LFP (Lithium Iron Phosphate), while graphite and LTO (Lithium Titanium Oxide) are the mostly used anode materials.
- **Battery Cell:** The battery cell is made up of the anode, cathode, electrolyte and a separator. Common form factors include coin cells, pouches and cylindrical such as 18650 and 21700.
- **Battery Modules:** The battery module is made up of multiple cells connected together, typically numbering from single digits to several hundred cells. There is a casing and electrical terminals.
- **Battery Pack:** The battery pack is made up of multiple battery modules (though it could be a single module too). This includes the battery management system, cooling equipment (if necessary) and electrical connections to the device to be powered.
- **Battery Capacity:** The most basic measure of a battery is in Amp-Hours. This is the current that the battery can supply until its voltage drops below some specified value multiplied by the time to do so. For example, a typical cell phone has a capacity of 3000 milli Amp-Hours (mAh) while an electric car might have thousands times that.
- **Battery Management System:** The battery management system monitors and regulates the operation of the battery. It needs to ensure the battery remains inside safe operating conditions while delivering the required performance.

Source of contents:

Reuben Bakker, Zong Yun, Institute of Materials Research and Engineering (IMRE), A*STAR, Singapore

Please contact us to learn more:
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SWAGELOK SINGAPORE PREPARES TO BETTER SERVE THE GROWING SEMICONDUCTOR INDUSTRY

Speed, consistency and cleanliness are major customer pressures in the semiconductor industry. To help lower those pressures and resolve customers' critical business pain points, Swagelok Singapore is proactively enriching, changing and improving its services and delivery times.

The emergence of smart cars and the release of a new range of technologies bring optimism to the semiconductor industry. These new technologies, which include industrial Internet of Things (IoT) as well as augmented and virtual reality, will bring huge challenges with greater opportunities. According to Eric Cheng, Swagelok Singapore's semiconductor market manager, we have to be ready to do more and be more. Semiconductor clients are looking for partners who can provide services like cleanroom weldments and assemblies. That's why Swagelok Singapore has invested heavily in equipment and facilities that provide the services most needed by semiconductor customers.

Leading Positive Change: Thinking and Working Differently

Recent Swagelok Singapore improvements include upgrading its cleanroom to full Class 100 and purchasing Lean Lift® and Rotomat® machines for storage and retrieval. The sales and service center also revisited its inventory management processes and enhanced stock readiness to sustain on-time delivery metrics.

These substantial, ongoing commitments showcase Swagelok Singapore's understanding of the importance of the cleanliness chain. The goal is to ensure that from raw material to the installation of components, maximum cleanliness is achieved for customers.

"We are optimistic that our semiconductor clients will clearly see the value of our changes," states Cai Zhuohan, Distributor Principal, Swagelok Singapore. "We're investing in our future and expect that these initiatives will accelerate our momentum to becoming a valued solutions provider."

About Swagelok Singapore

Established in 1974, Swagelok Singapore is a fluid system solutions partner offering services and products manufactured by Swagelok. Swagelok's facility is superbly equipped with warehouse, cleanroom, training center and assembly area to help clients address day-to-day problems.

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TOUCH

SEMICONDUCTOR TRADEWINDS JULY & AUGUST 2019

The semiconductor segment news in July and August 2019 has been dominated by two trade wars, the ongoing US-China trade war and more recently, the Japan-South Korea trade dispute. As a result, it has been a bit of a roller coaster ride for the semiconductor industry in the last few months, and as we head into September the situation doesn't look good with US & China both escalating the war at the end of August by announcing additional and increased tariffs which will be imposed in the coming months

The Trade Wars

The next big bump on the horizon that will have a big impact is the additional tariffs on the remaining US$300 billion of Chinese imports which will impact consumer electronic goods, like cellphones, TVs, computers/laptops, cameras, microwaves amongst other items. While some $110 billion of products, including smartwatches and wireless headphones, did have 15% tariffs implemented on 1st September 2019, a further $190 billion of products including smartphones, laptops and video game consoles have had the tariffs delayed to 15th Dec 2019 to reduce the impact on the Christmas season.

Apart from the tariffs, another direct impact on the semiconductor market is from the US adding Huawei to the "Entity List" due to national security concerns. This prevents US companies selling US derived technology to Huawei and its affiliates. The ban first announced in May has subsequently been delayed twice, each time by 90 days, to allow companies to adjust their supply chains. After the latest delay, the ban will now come into force on 19th November 2019. Although the reprieve is in place, a number of major companies have already stopped dealing with Huawei, and as a result Micron, Qualcomm and many others cited the Huawei ban in their quarterly announcements as bringing a negative impact. To date 130 applications for licenses to ship to Huawei have been made to the US Commerce Department, but so far none have been granted.

Huawei has also been making adjustments to its business plans. It has made 70% of its 850 workforce redundant at its US R&D arm Futurewei, citing that the ban prevented it from transferring developments back to China. In addition, Huawei Chairman Ren ZhengFei has announced a restructuring of the company to fight and overcome the ban for the next 3 to 4 years by spending more on production equipment and cutting redundant roles.

Another trade dispute that arose in the last 2 months is between Japan and South Korea. In July Japan issued export restrictions citing national security concerns against South Korea on certain key semiconductor raw materials including hydrogen fluoride gas and photoresists, and subsequently removed South Korea from its "white" export list of countries. The material ban has a potentially huge impact on South Korean companies like Samsung and SK Hynix which in 2018 sourced 84.5% percent of its fluorinated polyimide, 93.2% of its photoresists and 41.9% of its hydrogen fluoride (used for etching) from Japan. So far reports seem to indicate that Korean companies cannot find sufficient alternative sources of these materials and once the current stocks are used up it could have crippling effects. Although some progress has been made in this dispute as it has been announced that Japan has issued 2 permits to ship resists to Korea, the dispute at present doesn't look like being resolved anytime soon.

The impact of the trade wars and weak market sentiment have resulted in dismal results for the first half of 2019 and an uncertain outlook for 2019 as a whole for all segments. In terms of total semiconductor sales, they fell around 14% compared to the first half 2018 according to several market analysis companies. Memory manufacturers like Samsung, Micron and SK Hynix were worst affected down over 30% compared to the same period last year. For equipment manufacturers, SEMI reported that North American based equipment companies posted billings of US$2.03 billion in July down 14.5% compared to July 2018, and according to SEMI, silicon area wafer shipments in Q2 totalled 2,983 million square inches, down 5.6% compared to year ago and the lowest level since Q4 2017.

In terms of market leaders, Intel retained it's number one ranking in Q2 as the world's largest semiconductor supplier from Samsung which remained #2. In terms of global smartphone sales, Samsung maintained its number 1 position with 22% market share, Huawei came 2nd with 17%, with Apple in 3rd place with 11%.

In Earnings News

Here is a roundup of results reported for the 2nd calendar quarter. Intel reported revenues of US$16.5 billion up 2.5% in Q1 as Intel reported customers pulling in shipments over concerns oversupply risk. Samsung reported revenues of US$13.5 billion ups 6.6% for its semiconductor business due to increased demand from the memory sector despite weak market conditions. Memory maker SK Hynix didn't fare too well though as they reported their lowest revenue in 3 years at US$5.45 billion. Fellow memory company Micron also reported their latest quarter results were down 18% to 4.79 billion compared to Q1, and down 39% compared to a year ago, due to reduced revenue from stopping most shipments to Huawei. Qualcomm reported non GAAP revenues of US$4.7 billion, down 5.6% on the previous quarter due to slow smartphone sales. TI reported revenues of US$3.67 billion up 2% in Q2 due to resuming some shipments to Huawei. Infineon reported revenues up 2.2% QoQ to US$2.2 billion despite the slowdown in the automotive market, especially in China. NXP reported revenues of US$2.2 billion up 6% QoQ due to strong NFC chip sales for smartphones. ST Micro reported revenues of US$2.17 billion up 4.7% in Q1. STM reported seeing competing market dynamics with strong demand for more sophisticated chips and sensors for the smartphone and auto industries, but weaker demand for older and mass-markets products in the auto sector especially in china. AMD reported Q2 revenue up 20% in Q1 at US$1.53 billion due to strong GPU sales.

In the wafer foundry and test & assembly subcon world Taiwanese suppliers like TSMC, UMC & ASE reported consecutive months of growth in terms of revenue with July being the best month of 2019 so far. Some of this uptick in foundry and subcon loadings is due to Asian companies placing additional orders to replace the supply gap caused by the Huawei ban on US companies.

In Company News

Equipment manufacturer, Applied Materials, has agreed to acquire Kokusai Electric for $2.2 billion from investment firm KKR. Kokusai makes epitaxial and thermal processing batch processing equipment for the semiconductor market and will allow Applied to increase its customer base.

Sensor manufacturer AMS made a US$4.1 billion counterbid for lighting company Osram, which was higher than the previous US$3.8 billion bid by private investment companies Bain and Carlyle. The AMS deal potentially offers the merged company to rapidly expand the value chain, especially in the automotive market. As Osram has waived the so-called "standstill" agreement to allow the bid to be discussed, the Osram shareholders now need to decide which bid to accept.

In Singapore news, POET Technology signed a definitive agreement to sell its Singapore based subsidiary Denselight Semiconductors to Chinese based Denselight Semiconductor Technology (Shanghai) for $28 million subject to shareholder agreement. Denselight Semiconductors is the manufacturing arm of POET Technologies manufacturing InP devices.

Micron officially opened their Singapore Fab 10 expansion. Built on a 165,000 m^2 land plot area next to the existing Fab 10N & 10X Fabs, the extension will enable the Singapore Fab to start production of 96-layer 3D NAND sometime in the second half of this calendar year.

Overall the outlook doesn't look very bright for the semiconductor market despite the slight upturn seen in Q2. There is a lot of uncertainty around caused by the trade wars which driving down consumer sentiment. This has caused many companies to be very cautious and delaying supply decisions which doesn't bode well for the traditional holiday season uptick typically seen in the second half of the year. Let's hope we get some clarity soon.

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AI-ENABLED ELECTRONIC INTEGRATED CIRCUIT DESIGN

The Integrated Circuit (IC) design process is one of the most complex and resource-intensive processes in the design field. The time taken to design and validate the IC design can take months and the design of mixed-signal/ RF/mm-wave ICs is usually a laborious process.

Over the past 10 years, the IC design research institutes, centers and teams in Singapore have developed a myriad of IC circuit and sub-system design Intellectual Property (IPs). These IPs cover a wide range of applications such as automotive, electronics, semiconductors, telecommunications, computers, healthcare, satellite and internet.

While the documentation of these designs vary in format, this presents a huge pool of unstructured data which can potentially be made available for future designers, researchers, startups and emerging fabless companies to access and develop innovative designs and new applications.

Hypotheses and Methodology

2018 marks the 50th anniversary of Singapore's semiconductor industry. Today, the semiconductor industry is a key pillar of Singapore's economy, accounting for one-third of Singapore's total manufacturing output and contributing 4.4% to GDP. It also supports over 34,000 workers, amounting to about 10% of Singapore's manufacturing workforce.

Hitherto, Singapore is proud to host 14 wafer fabrication plants, 40 IC design companies and 19 Assembly and Test facilities (A&T) in our native land. However, Singapore's thrust and achievement in nurturing IC design startups pales in comparison to that of the US, China, Korea and Taiwan. This may be one of the factors suppressing Singapore's success in international competitiveness. About 80% of the 40 IC design companies in Singapore are foreign players. While it is an apparently revered and rewarding strategy to help grow the economy by leveraging foreign IC design companies' participation in Singapore, it is also imperative for the nation to groom more domestically based fabless/pure-play IC design houses to fuel and further foster the growth of the semiconductor ecosystem in Singapore.

With the adventures in Artificial Intelligence (AI), the time has come for Singapore to use AI technology to develop a common IC design knowledge database. This Intellectual Property (IP) database will be used to develop intelligent methodologies to accelerate and automate the IC design process, IC chip manufacturing process and eventually democratize the IC chip design.

Innovative Concepts

The beauty of diversity in the semiconductor industry is that different players leverage on and bolster each other while promoting a realm for innovation and vigorous competition. Singapore's strong foundation and overwhelming gestation of manufacturing plants, A&T infrastructures, and other supporting industries contributing to the semiconductor value chain of activities should provide a fertile platform for enterprise creation. However, by taking a closer look, it is not difficult for us to notice that the opposite is true.

At present, there is an apparent and severe inadequacy in the number of IC design companies in Singapore, especially the homegrown segment. This phenomenon is illustrated in Figure 1. This severe scarcity, to a large extent, is attributed to the high entry barrier due to expensive EDA tools and manpower issues viz. the shortage of high-caliber IC designers.

Furthermore, IC design houses, being fabless, are talent-intensive instead of labour-intensive and are free from the exceptionally high fixed cost of internal fabs resources. These facts and figures motivate and further intensify the need for a transition into a high value-added, design-driven industry in order to remain competitive in global markets. We are in urgent need of the existence of a more established cluster of IC design companies in Singapore.

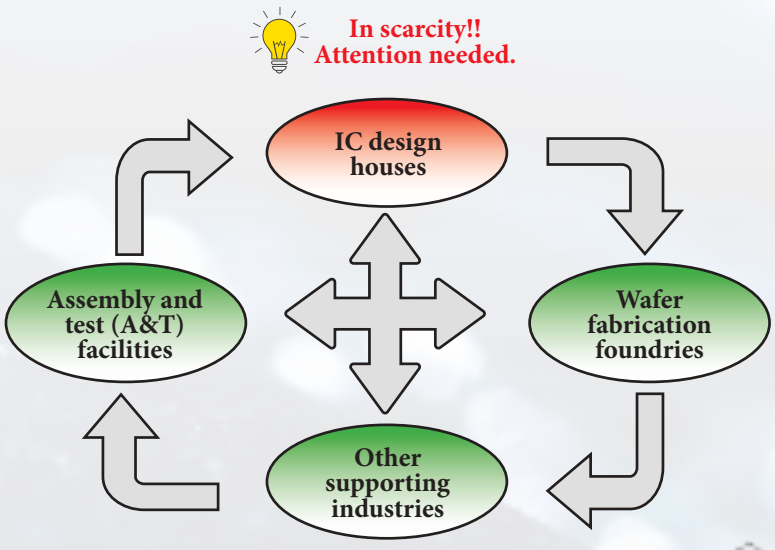

Figure 1: The current situation of the semiconductor value chain in Singapore

Objectives of an AI-driven IC Design Internet Platform

1. To devise the world's first AI-driven IC design internet platform where existing IPs can be shared and traded, new IPs can be jointly created and optimized as well as new products and applications can be produced more reliably, cheaply and quickly.

2. To be the first in the world to use Blockchain technology to protect the usage of semiconductor IPs.

3. To develop a smart EDA design workflow management system to manage IC design workflows using multi-vendor tools, IP's, and manufacturing processes.

4. To ensure a secure and state-of-art cloud-based EDA design platform system suitable for multi-organization usages and collaborations.

5. To catalog and standardize the large quantity of existing IC IP's designs and integrate them into the design platform for future design reuses to improve overall design productivities and efficiencies.

6. To develop methodologies and software for electronic IC design that is driven by AI.

7. To experimentally demonstrate and validate devices and systems that are designed by our developed AI-methods and software.

8. To demonstrate competitive advantages and capabilities of the proposed AI approach in terms of the performance, reliability and robustness.

Roles of AI-Enabled Electronic IC Design

AI techniques are only as good as the data they are trained with. However, data from previous designs may not be enough for AI to perform the necessary design operation and optimization. There is also real-time data. But real-time learning can be challenging because when something goes wrong, we have to be able to debug, recover and repair the streaming data. Hence, as shown in Figure 2, the roles of AI-enabled electronic IC design will

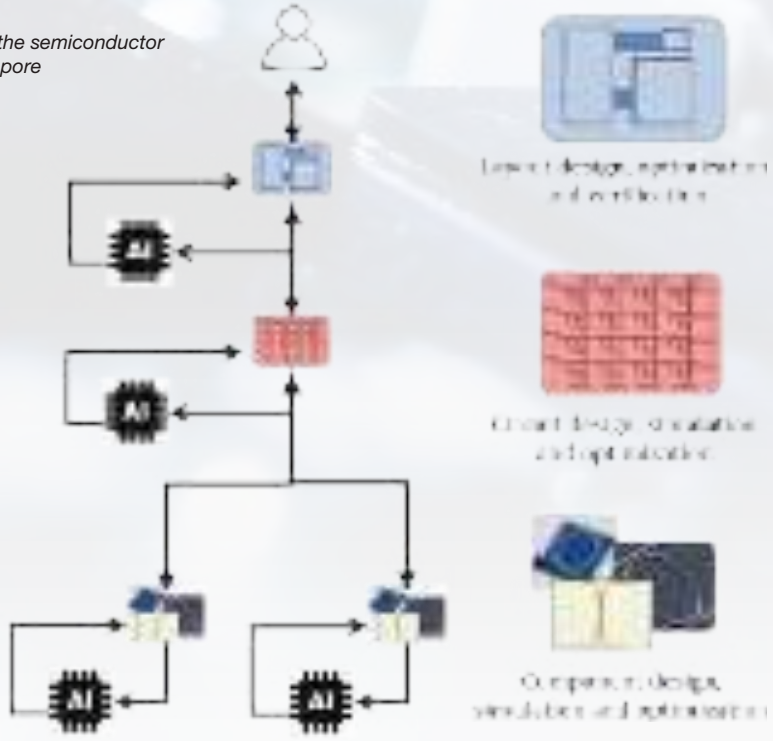

Figure 2: Robust design of components, circuit and physical layout with AI methods

1. Learn the well-defined IC design parameter space: establish experimentally-tested numerical libraries for this parameter space.

2. Create AI-based Product Development Kit (PDK).

3. Explore AI-generated device geometries for better performance, low power, low losses and new functionalities.

4. Demonstrate footprint reduction, auto-placement of devices while minimizing losses.

5. Accelerate of numerical simulation with deep learning-based meta-models.

6. Create a platform for AI-assisted computational optical lithography.

Significance and Potential Impact

At the 2016 RIEC press conference, Prime Minister Lee Hsien Loong urged Singaporeans to delve more into innovation and enterprise, and research and development to rejuvenate future economic growth. Indeed, the AI-enabled electronic IC design and IP database will facilitate Singapore-based IC design professionals to form IC design companies with a continual stream of technical prowess.

The following methodologies will be carried out to ensure the ultimate success of this mission:

Method 1: Attract investment with the Smart IP Database - The smart IP database will act as a major think-tank for the invention of more silicon IP with greater value and increased reusability. It will also focus on the protection, management, and distribution of IP, and royalty collection. With the underlying strength in semiconductor market, including ASICs and systems on chip (SoCs), the silicon IP industry is expected to show unrelenting growth in years to come. A high growth potential of the IP sector will attract more venture capital investment. These investors are keen on identifying companies with innovative IP that will be very much sought-after by a myriad of Original Equipment Manufacturers (OEMs).

Method 2: Using Local Foundries for Local Start-Ups (Local for Local) - The IC design houses of China, Korea and Taiwan prefer and choose to outsource their chip production to their respective domestically-based manufacturing foundries (EE Times, 2005). There is a judicious rationale behind this model. The IC design companies and fabrication plants are actually working hand in hand to create markets and business opportunities for each other. Moreover, the turnaround time and time-to-market of chips fabricated locally are much shorter compared with those fabricated in overseas foundries. In view of this, it will be one of our important strategies to enter into an agreement with IC design companies under our umbrella to outsource fabrication of their chips to local fabs. It is imperative for us to adopt this similar trajectory to stay afloat in the immensely heated competition of global IC design market.

Method 3: Grooming of an Army of IC Design Talents - To stay globally competitive, Singapore has to continually move up the value chain and create new economic and knowledge-based industries. Human capital and talent are critical components of the equation. Therefore, the endeavor of nurturing a cadre of high-caliber local talents requires unrelenting and ongoing efforts. To ensure that manpower issues do not hinder the growth of our pure-play IC design cluster, we need to have a significantly larger pool of IC design talents, from which potential entrepreneurs can emerge. As a result, one of our main objectives is to groom, nurture, and produce adequate numbers of versatile IC designers to contribute to the Singapore economy where the electronic sector remains to be the core pillar sustaining the growth of the nation.

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DEEE INDUSTRY DAY 2019

SSIA was invited to attend the Diploma in Electrical and Electronic Engineering (DEEE) Industry Day on 17 Sep 2019. The main objective of this event was to raise awareness among the students on the full potential of the relevant industries and the available career opportunities upon their graduation, guiding them towards a brighter future and realizing their full potential in life. There were about 100 DEEE year-three students and around 15 companies participating in this annual event.

The keynote speech was given by EDB Senior Lead, Semiconductors, Ms Crystal JX Ang, followed by talks given by companies including Ardentec, Denselight Semiconductor, GLOBALFOUNDRIES and National Instruments Singapore. The School also signed MOUs with Beyonics International Pte Ltd, National Instruments Singapore Pte Ltd and Schneider Electric Asia Pte Ltd to strengthen its collaboration with the industry sector.

When it comes to managing trade…

- Compliance benefits
- Direct cost savings
- Indirect cost savings
- Business opportunities

…compliance is just the tip of the iceberg

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WHEN IT COMES TO MANAGING TRADE, COMPLIANCE IS JUST THE TIP OF THE ICEBERG

Most semiconductor companies have long accepted that the burden of trade compliance is not going to go away anytime soon.

Many such businesses have turned their compliance workload on its head and now see customs as the starting point for a range of value-adding activities.

Let's deal with the activity itself. The old view of customs compliance suggests going through dusty piles of paper, filling out forms and negotiating with surly customs officers.

Nothing could be further from the truth

The modern world of customs is one where the client's ERP, the customs broker's declaration application, and the national customs platform are at least partially connected, with brokers having to intervene only minimally at the declaration stage.

This should be the objective of every business but is particularly critical in an industry as sensitive as that of semiconductors.

The most important thing in such automated environments is ensuring that all declarations flow through a single system irrespective of trade terms, and your customs broker can guide you on how to achieve this.

Now to extract value from the process

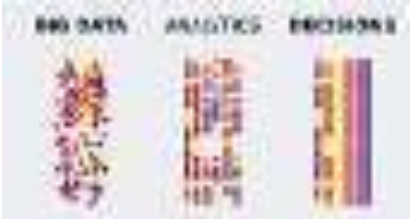
With all customs data flowing through a single system, the client and their customs brokers will then be able to produce a broad, trusted and verifiable trade data set.

This data set is then used to build reports monitoring compliance, highlighting exceptions and showing opportunities to add value.

Examples of exceptions highlighted might be irregular use of HS codes, outlying customs values, or mismatches of HS codes and declaration types used.

Areas of added value that companies enjoy from working on a single, structured customs data are opportunities to use free trade agreements, better use of government-mandated trade schemes, and even wholesale supply chain reconfiguration which can change the country of origin to make products more competitive.

In fact, some customers have seen the savings achieved by viewing their customs data through a single lens run into many millions.



Conclusion

A professional approach to customs and trade compliance activities provides a broad, trusted and verifiable data set, minimizing processing cost and unlocking growth opportunities.

Data used in customs management processes should be digitized, structured, encrypted, and derived from every source wherever possible.

Customs management processes using digitized structured data are auditable, secure and provide a sound basis for business reports and building value.

Talk to TNETS today about how to deliver the benefits of a professional and comprehensive approach to customs.

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BEHIND-OLED SENSORS ENABLE DESIGN OF BEZEL-LESS PHONES

New Developments In Ambient Light Sensor Technology Support Mobile Phones' Display Management Capabilities

The ambient light sensor (ALS) or color sensor has become a common feature of mobile phone designs. An ALS measures the intensity of environmental light incident on the display screen, providing information that lets a processor adjust the brightness of the display backlight in response to ambient lighting conditions.

When equipped with a color sensor in place of an ALS, the mobile phone can also adjust the dis-play's rendition of color in response to the difference in color temperature between, for instance, indoor LED lighting and sunlight. Either sensor type provides for a better viewing experience and lower power consumption.

An ALS or color sensor for display management has traditionally been located in the bezel at the top of the user side of the phone, where it has an unimpeded view of ambient light. New designs for high-end smartphones, however, have eliminated the bezel to maximize the size of the display. Mobile phone makers are therefore looking to implement an ambient light-sensing system which can be mounted behind the display.

The difficulties of sensing incident light from behind an emissive layer are, not sur-prisingly, considerable. Various approaches to the problem have been suggested by providers of light-sensing technology. Now ams has developed a solution which exceeds the mobile phone manufacturers' requirement for measurement accuracy while providing

the design flexibility to locate the ALS anywhere behind an organic light-emitting diode (OLED) display.

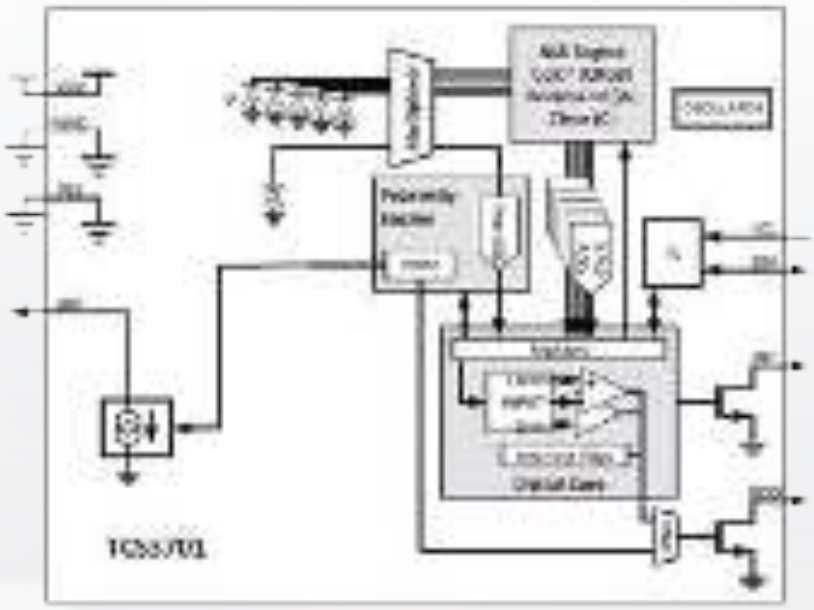
OLED display technology is rapidly replacing liquid crystal displays because it offers higher con-trast, more vivid and accurate color reproduction, and lower power consumption. But how is it pos-sible to perform sensing of ambient light incident on a surface that itself emits light at an intensity high enough to provide a vivid and engaging viewing experience?

Ultra-high Sensitivity ALS

An OLED display is somewhat transparent: its complex structure diffuses incident light but does not block it. An OLED display in a phone has an opaque, reflective thin backing which provides a uni-form optical background for the display's emissions. A small (approximately 1mm in diameter) aper-ture cut into this backing will allow ambient light to pass through an OLED display to an ALS sensor mounted on the PCB beneath it.

The difficulty in implementing ambient light-sensing behind-OLED is that light emitted by the display also reaches the ALS, interfering with the ambient light measurement. The challenge is, therefore, to subtract the light emitted by the OLED display from the ambient light sensed by the ALS device's photosensors, to give a true measure of ambient light intensity.

The ALS performance requirement for effective display management is lux measurement accuracy of at least ±10%. (Lux is the unit of luminance, or light intensity incident on a surface.) When cali-brated in the handset, ams ALS devices mounted in the bezel typically achieve lux measurement accuracy of better than ±5%.



TCS3701 ALS chip and Evaluation Kit for TCS3701

Achieving the required accuracy when mounted behind an OLED screen is much more difficult than when bezel-mounted. This is why ams has developed the TCS3701 ALS chip which offers very high photo-sensitivity – some ten times higher than that of ALS chips used in conventional bezel-mount designs.

This high sensitivity provides a very broad full-scale lux measurement range: the benefit of this is that small lux values attributable to ambient light may be detected when a much larger lux value attributable to the display is subtracted from the total measured value.

The operation of this solution for ALS Behind-OLED also depends on the ability to cancel out the effect of the light emitted by the display: this is achieved with complex algorithms developed by ams.

The ams Behind-OLED Sensor: Proven Performance

It is this combination of high-sensitivity hardware and sophisticated software which enables the effective operation of the ams Behind-OLED solution. It has achieved calibrated lux measurement accuracy of better than ±10%, exceeding the performance target set by phone manufacturers.

The effective operation of the ALS device is supported by the optically diffusive structure of the OLED display, which means that the sensor works at most incident angles without requiring a wide field of view.

The ams Behind-OLED solution enables phone manufacturers to retain the valuable display bright-ness adjustment function as they make the transition to OLED display technology in the new sleek, bezel-less display designs favored by today's users.

For more information about the ams portfolio of Behind-OLED solutions visit https://ams.com/display-management.

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USHERING IN THE NEW GENERATION INTO THE ELECTRONICS INDUSTRY

CHIPS@SCHOOL COMPETITION BY INFINEON

To spark students' interest in STEM (science, technology, engineering, and mathematics) studies and career, Infineon Technologies hosted the Chips@School Competition inviting secondary school students to create innovative ideas of applications. First established in Germany in 2012 and brought into Singapore in 2015, this competition program has been in its fifth year. The theme for this year is 'AI and Us' with 144 students from 11 secondary schools across Singapore participating in the competition. Participating teams were required to present ideas which can make the world a much better place with artificial intelligence.

On 3 September 2019, 10 shortlisted teams were invited to Infineon Singapore to present their ideas. Representatives from the semiconductor and electronics industry were invited as the judging panel. They include Ang Wee Seng from Singapore Semiconductor Industry Association (SSIA), Dr Teo Tee Hui from SUTD, Roxane Desmicht and Robert Tan from Infineon Technologies. The judging criteria considered creativity and intelligence of the idea, the presentation as well as the diversity in members among the team.

The judging panel was impressed with the innovative ideas and presentations from the ten participating teams

Confident and Impressive Student Presentations

The standard of the innovative ideas presented impressed the visitors and the judges. All of the students presented confidently, showing good camaraderie and teamwork in light of close and keen competition. Participants were also excited to raise questions challenging concepts behind other competitors' projects after the presentations, allowing engaging and energetic interactions between the young generation.

"It was a tough decision to make as all ten projects were good!" said Mr Ang Wee Seng, Executive Director of SSIA. "I was really impressed by the presentations at the competition. Although the ideas were still in a very conceptual stage, they were very insightful in terms of looking for solutions to real-world problems observed by them. It has actually demonstrated the design thinking mindset which an engineer should acquire."

The day ended with three winning teams. The first place went to Raffles Girls' School with their project 'Smart Bins'. The judges were impressed by the idea of using AI in dust bins to track and predict eating habits by sorting and recording the collected trash.

"I have never thought of winning the championship in the competition. I think, after doing this presentation, that it gives us a better insight into how we can incorporate AI technology into products which can make our lives easier and better. It's a great opportunity for us to gain more knowledge on microelectronic application and semiconductor technology," said Gan Kah Shuen, participant from Raffles Girls' School.

The second place went to Paya Lebar Methodist Girls' Secondary School for their 'AIERA Robotic Reception-Nurse Assistant' idea. Hwa Chong Institution was awarded the third place for their 'FR"AI"DGE' idea.

Foster Creative Minds and Innovative Ideas

At the end of the event, a special guest – an alumnus of this competition, Benjamin Teng, who have joined the competition for two years were invited to share his experience.

"This competition has sparked my interest in science and technology. That's why I am now pursuing Science. I also plan to pursue my career in the semiconductor arena," said Benjamin

Active and interactive participation at the competition

Ms Roxane Desmicht, Head of Corporate Supply Chain, Asia Pacific of Infineon Technologies, said in her closing speech, "With the exposure in this competition, we hope the participating students will learn more about problem-solving with science and technology. It will be our pleasure to see them joining the workforce in our industry, contributing to a safer, easier and greener world with disruptive technologies in the future."

Companies who are interested in co-hosting school competitions about electronics and semiconductor with SSIA, please contact secretariat@ssia.org.sg

Benjamin Teng sharing his experience of joining the competition

Congratulations to the team of Raffles Girls' School for winning the Champion with their 'Smart Bins' idea

SCHOOL OF PHYSICAL AND MATHEMATICAL SCIENCES IN NTU

AN IMMERSIVE LEARNING JOURNEY IN PHYSICS OF SEMICONDUCTOR

The School of Physical and Mathematical Sciences (SPMS) at Nanyang Technological University, Singapore (NTU Singapore) offers undergraduate and graduate degree programmes in the disciplines of physics, chemistry, and mathematics. Originally established in 2005, it now produces around 400 graduates with Bachelor of Science degrees, and around 80 PhD holders, every year.

Rigorous But Flexible

Its undergraduate degree programmes in Physics and Applied Physics, which have about 80 graduates each year, are structured to provide a broad knowledge of physics and its modern applications. Subjects offered to students include the Physics of Semiconductor and Spintronics Devices, Quantum Electronics, Photonics, and Fabrication of Micro- and Nanoelectronic Devices.

"We make great efforts to train our students not only in the content of physical laws but also how those laws are applied in the real world," says Associate Professor Elbert Chia, Head of the Division of Physics and Applied Physics at SPMS. "For example, we have a rigorous three-year physics laboratory sequence, where the third year labs involve semester-long stints in our professors' physics research laboratories. There, our students are exposed to the actual practice of nanofabrication, device characterisation, and other procedures."

He added that all Physics and Applied Physics undergraduates are required to undertake either a two semester final year research project under the supervision of a faculty member, or a 5½ month internship in an established company or organization. Semiconductor companies that have hosted SPMS interns include Micron, GlobalFoundries, Siltronic, and Applied Materials.

Fulfilling Careers In Semiconductor Industry

Many faculty members in the Division of Physics and Applied Physics are renowned experts in research areas relevant to the semiconductor and advanced manufacturing industry. For example, Professor Lew Wen Siang and Associate Professor S. N. Piramanayagam are leading experts on emerging non-volatile memory materials and spintronics devices, and their research teams often work closely with local industry partners; Professors Yu Ting and Fan Hongjin are leaders in battery and supercapacitor technologies; and Professors Xiong Qihua and Christos Panagopoulos perform cutting-edge research on semiconductor materials.

"All these professors do a great job of mentoring undergraduate and PhD students, many of whom go on to fulfilling careers in Singapore's semiconductor industry," says Professsor Chia.

Associate Professor Elbert Chia,
Head of the Division of Physics and Applied Physics at SPMS

The vibrant research and education environment at SPMS is increasingly recognized internationally. In the most recent QS Rankings for Physics, NTU placed at number 28 globally, ahead of more established institutions like Ecole Polytechnique, the University of Michigan, and the University of Texas at Austin.

To further strengthen the connection between its physics curriculum and industry, SPMS is launching a new BSc in Applied Physics with Second Major in Microelectronics Engineering. The new undergraduate degree programme, which will be run in conjunction with NTU's School of Electrical and Electronic Engineering, aims to produce students who are trained not only in existing microelectronics techniques, but have the flexibility and creativity to take on the industrial challenges of the future.

For more information, visit the SPMS website at spms.ntu.edu.sg

Powertech Technology (Singapore) Pte. Ltd.

Semiconductor solutions provider focusing on versatile, customer-oriented and automated manufacturing, offers Wafer Bumping, Chip-Probe Test and Die Process Services / Backend-2, aiming towards greater intelligence, quality, flexibility and cost-effectiveness.

PTI-SG, a subsidiary of Powertech Technology Inc., offers a **full turnkey solution** with seamlessly integrated production, focus on responsive, adaptive and connected manufacturing using disruptive technologies and aiming towards Industry 4.0 and Smart Factory transformation.

EXCLUSIVE INTERVIEW WITH e2i CEO

The world economy is hit by a downturn and the semiconductor industry in Singapore and the region is not spared. Besides, new technologies emerging in the era of industry 4.0 have redefined roles and skill requirements of many positions in the sector. These factors have led to a need for companies to retrain and restructure their workforce; at the same time, a need for employees to equip themselves with the proper knowledge and skills to meet the market demand.

The Employment and Employability Institute (e2i), a workforce development agency established under NTUC, strives in creating solutions for better employment and employability for different industries. Voice Magazine had the chance to chat with their CEO, Gilbert Tan, about his views and e2i's initiatives in supporting the workforce development of the industry.

Singapore's semiconductor industry is facing a challenging time due to the trade wars and companies are facing a slowdown of business growth, what is e2i seeing in terms of employment for this sector?

Gilbert: We are seeing a trend of companies hiring in smaller numbers; however the demand for skilled workers in the semiconductor industry remains. There is also a shift in the profile of the candidates that companies are looking for. Companies are increasingly looking for workers who are skilled in software, data science, automation and analytics fields as well as other related digital and IT jobs.

There is also demand from employers turning towards skilling up their existing workforce in adaptive skills such as problem-solving, communication skills and technological skills such as coding and software, data analytics and cybersecurity. These skills are aimed at transforming the workforce to be ready, resilient and relevant for the upcoming challenges in industry transformation.

With the challenging labour market conditions, what should companies do to manage the excess manpower?

Gilbert: We encourage companies to approach NTUC's e2i or their respective union early and see how we can best support them to manage the challenging business situation. Early intervention is critical as we can support companies to look at re-skilling their workers to upgrade their skillsets so that they are able to take on other job roles within the company or look at strategic job

redesign to improve business prospects and prepare for the upturn.

If the company has to release staff after considering all options to save the workers, we have in place teams to support the affected workers through career coaching, training and placement to help them transit into their next job.

Are there any initiatives targeted at the semiconductor and electronics industry during this period?

Gilbert: As the sector slows down, companies can see this as an opportune time to focus on strategic business transformation and look into jobs re-design and skills upgrading of their workers. For unionised companies, they can consider partnering the Labour Movement to set up Company Training Committee (CTC) where both management and the union can work together to identify training and skills to nurture workers to be future-ready and be Worker 4.0.

e2i actively reaches out to our network of companies and trade associations such as Singapore Semiconductor Industry Association (SSIA), to prepare the local workforce and train them up with future-ready skills to remain relevant and resilient. We leverage the close collaborations with our training partners and Institutes of Higher Learning (IHLs) to bring suitable training and masterclasses to train workers with new skills and knowledge. For example, we are running the EPME (Electronics and Precision and Machinery Engineering) Week for the third year which entails a week-long line up of training activities in trending topics such as 5G technology, advanced manufacturing skills. More details are on the website https://e2i.com.sg/industry-information/electronics-and-precision-engineering-EPME

We also partner companies to hold regular career fairs and placement events to assist the locals and employers in job-matching within the sector or across sectors.

Career Fair

How should the workers prepare themselves if they are worried about their current job?

Gilbert: Digitalisation is disrupting the way we work and it is happening across all industries. The key is for workers to take a proactive role to acquire adaptive, technological and technical skills in order to future-proof themselves and navigate the future workplace. It is hence important for workers to embrace a lifelong learning mindset and stay up to date with the latest developments in the industry and keep abreast for the skills required for both their current and future job roles.

For unionised workers, they can approach their union leaders to share about their concerns and training needs; and if the company has a Company Training Committee set up, they could better coordinate training efforts even as the company transforms. Skills upgrading is critical to maintaining job security so that workers continue to grow their skills sets and competencies to value-add to their organisatons as industry changes take place.

Workers can seek out self-assessment tools to see if there are any current skill gaps and look for suitable training to plug those gaps. Individuals may wish to check out the Career Pitstop (https://careerpitstop.e2i.com.sg/) which is one of our assessment tools developed by e2i - to conduct one's own career health check. They can also consider meeting e2i's career coaches who use tools to help them be more aware of their strengths and weaknesses, give them advice and propose suitable trainings, so that they can make more well-informed decisions in their career journey.

> **“Early intervention is critical as we can support companies to look at re-skilling their workers to upgrade their skillsets so that they are able to take on other job roles within the company or look at strategic job redesign to improve business prospects and prepare for the upturn.”**

WORKFORCE CHALLENGES FOR SME

Small and medium enterprises (SMEs) are considered the driving force of the semiconductor industry in Singapore and a strong talent pool is one of the prerequisites to sustain its growth. However, a recent survey by the Singapore Semiconductor Industry Association (SSIA) conducted at the SSIA SMEs HR Conference in August 2019 has revealed most of the companies surveyed currently grapple with manpower challenges.

Out of the 16 SMEs in the semiconductor industry, 50% have indicated the average number of years of employment of their staff was 2 to 4 years, and only 12.5% said the number was over 10 years. The 3 top reasons why their staff left were better career opportunities, advancement and career change.

The figures were lower than those from Multinational Corporations (MNCs), where 58.9% and 17.6% of 16 MNC companies indicated the average number of years of employment of their staff was 2 to 4 years and over 10 years respectively, in year-end of 2018. (see Figure 1)

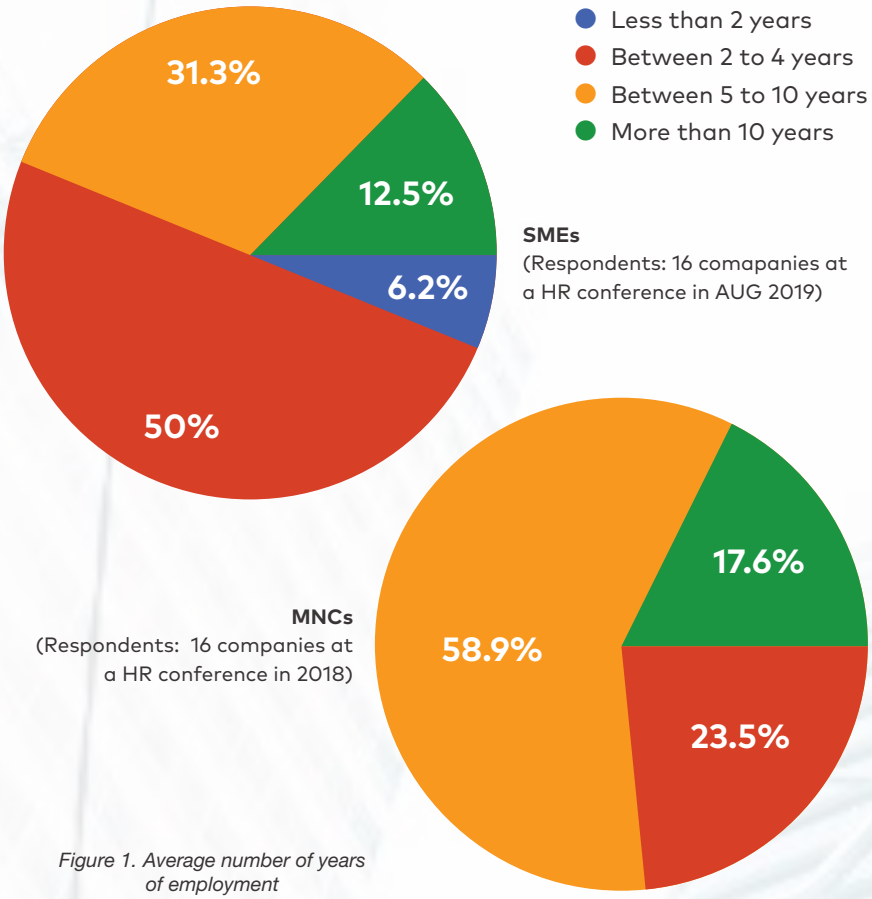

Figure 1. Average number of years of employment

Challenges In Hiring Talents

"The business challenges lie in difficulty to hire the right talents, especially good design engineers," said Terry Teh, Director of Advinno Technologies Pte Ltd, an Electronics Design House (IDH) focusing on design and manufacturing of semiconductors and electronic systems. "This phenomenon has been there for many years but getting more serious as there are very few locals who are willing to work as engineers. Furthermore, with the government tightening the Employment Pass, we can't even get engineers from Malaysia, India and the Philippines."

Graphene Semiconductor Services Pvt. Ltd, another SME which provides end-to-end solutions to semiconductor companies, is facing the same problem. "Highly-skilled professionals are limited in the domain of Electronics & Communications (VLSI). The pool of experienced engineers with the desired skills (knowledge in deep submicron technologies like 10nm & 7nm) is extremely limited and inadequate to work on projects with chip design foundries," said Ajay Kumar, Director of Human Resources of the company. Kumar added most of the engineers who graduated from universities look at other areas like technology and business management, making it harder to find new blood for the industry.

Retaining Skilled Employees

Retaining skilled employees is one of the solutions for the current talent shortage problem. At Advinno Technologies, the management has provided their staff with flexible working hours, as well as

subsidies and time allowance for staff enrolling relevant training courses. "We hope these measures will make our employees feel valued," said Terry. Kumar told Voice his company has been rolling out a localization plan to strengthen local hiring with the support of Employment & Employability Institute (e2i), Workforce Singapore (WSG), Universities such as NTU & NUS and SSIA.

Both of the companies also expected the Singapore government to inject support on bringing in new talents, such as increasing the intake of engineering students in universities and giving special concession to hire engineers from overseas.

"Awareness sessions to parents in schools briefing them the career progression of their children in the semiconductor and electronics industry can also help to attract the young generation joining the industry," added Kumar.

SSIA's Initiatives To Support Workforce Development

"There is a perception that semiconductor and electronics industry is a sunset industry, and unfortunately, this sentiment has influenced students to stay away from pursuing a career in this industry. Moreover, joining an SME may seem to be less attractive than working in an MNC for the fresh graduates, or even for existing employees, " said Ang Wee Seng, Executive Director of SSIA.

In line with the Singapore Electronics Industry Transformation Map (ITM), SSIA has been launching different workforce development strategies which will help to build and grow the pool of talent for the future of this industry. They include the Professional Conversion Programme (PCP), Singapore Semiconductor Leadership Accelerator (SSLA), school outreach programme providing an extensive platform for both students and industry to connect and engage with each other, and professional masterclasses to equip peers in the industry with necessary skills to capture new opportunities.

Career talk at a secondary school

Class of the SSLA course

"SSIA will also roll out a Semiconductor Communications Campaign next year, aiming to attract more students joining the industry after they graduate. We believe the different initiatives will help nurture a more nimble and dynamic workforce in Singapore. Besides, we will continue working with SMEs in the industry to plan out programmes which can support their workforce development."

"The business challenges lie in difficulty to hire the right talents, especially good design engineers." Terry Teh, Director of Advinno Technologies Pte Ltd"

SSIA INITIATIVES ON WORKFORCE DEVELOPMENT

FOR STUDENTS

School outreach initiatives

Career talks to schools & public

FOR INDUSTRY LEADERS AND EMPLOYEES

Singapore Semiconductor Leadership Accelerator (SSLA)

HR Roundtable for MNC and SME

Semiconductor Communications Campaign (to be rolled out in 2020)

Professional masterclasses (e.g. Operational Excellence, Cost Optimisation, Semiconductor Fundamentals)

FOR JOB SEEKERS

Career Fair

Professional Conversion Programme (PCP)

PROFESSIONAL CONVERSION PROGRAMME (PCP) FOR ELECTRONICS INDUSTRY

SSIA is the programme manager for Electronics PCP. This programme aims to help mid-career PMET to reskill and acquire new skill set to make a career switch within participating companies based on the job opening available.

MODES OF DELIVERY

PLACE-AND-TRAIN

PMET is hired by a participating employer before undergoing training to take on new job role

ATTACH-AND-TRAIN

PMET is provided with training and work attachments, in advance of job placement, through industry partners in growth sectors with good future job opportunities

REDEPLOYMENT

PMET at risk of redundancy is retained by existing employers and provided with training to take on new job roles within the same company

BENEFITS

- Facilitate recruitment of career switchers to meet employers' manpower needs
- Tap on Government funding through Course Fee Grant and Salary Support / Training Allowance
- Leverage structured industry-recognised training
- Minimise redundancies and reskill experienced employees to take on new job roles

SYSTEMS ON SILICON MANUFACTURING COMPANY PTE LTD

"In SSMC, we have a comprehensive competency development framework to equip and successfully transit mid-career PMETs into the wafer fabrication industry. The PCP is a good initiative to develop more engineering talents to support Singapore's vision of a SMART nation"

Mr Jagadish C.V.
CEO of Systems on Silicon Manufacturing Company Pte Ltd (SSMC)

"I was previously from the healthcare sector. The PCP has enabled me to master the technical skillset required to perform in the semiconductor industry. I am glad SSMC supported me to develop competency for my role in Quality & Reliability Assurance."

Ms Pascale Tan Peck Hui
Technical Manager of SSMC

STATS CHIPPAC PTE LTD

"The re-skilling and upskilling of our workers is critical in the arena of advanced packaging technology, where we face rising competition and cost pressures. The PCP provides us with the leverage to move up our workforce during these challenging times."

Mr Willy Wang
Managing Director
STATS ChipPAC Pte Ltd

"Through the skills upgrading programme, I have built up my expertise on sophisticated machinery through the intensive training provided by various stakeholders. These skills and knowledge acquired will boost my career path in the semiconductor industry."

Mr Michael Chong Mun Kay
Senior Equipment Engineer, Assembly (Pre-Assembly)
STATS ChipPAC Pte Ltd

Programme Manager:

SSIA Singapore Semiconductor Industry Association

For more information on PCP for Electronics, please contact
pcp@ssia.org.sg

EXPLORING NEW POSSIBILITIES IN ELECTRONICS

Electronics Industry Day 2019

The electronics sector is entering an exciting period with the rise of new applications such as autonomous vehicles, wearables and advanced mobile technologies that come with the advent of IoT and Industry 4.0. While such smart transformations spell exciting opportunities for the sector, it is also creating demand for new job roles and skillsets.

The inaugural Electronics Industry Day organised by JTC on 1 November 2019 aims to engage our young talents early and ready them for the future demands of the industry. The event includes visits by students from Polytechnics, ITEs and universities to companies within Tampines and Pasir Ris Wafer Fab Parks - Siltronic, SSMC, Soitec, UMC, Jabil and AMS, where they will be given an opportunity to have a real look at the workings of the electronics sector, and have a better understanding of careers in the field.

The event will also see 20 companies from the electronics industry showcasing their innovations and technologies that will offer students a look at real-life applications. This will go towards increasing students' knowledge and interest in the electronics sector.

The event will also showcase projects completed by the Polytechnic students. By bringing and academia partners together, it will help businesses meet their current and future skill needs, and build a talent pipeline for the industry in the long run.

The event will also feature activities such as drone challenges, autonomous vehicle rides, and IMDA Lab On Wheels, where visitors can hop on to these thematic buses to learn about Artificial Intelligence and Immersive Media through engaging hands-on exhibits.

Lab on Wheels will also offer experiences in various immersive technologies such as augmented reality, virtual reality and mixed reality.

Creating Sustainable And Attractive Work Environments

As our workforce evolves, the needs of workers are changing as well. With the manufacturing scene being reshaped by new trends such as automation and digitalisation, it is also raising questions as to how the manufacturing work environment needs to be designed to attract and retain future talent. There is increasing focus on making our estates more sustainable given the increased focus on environmental sustainability.

JTC Corporation (JTC) is starting these efforts at the Tampines and Pasir Ris Wafer Fab Parks, where enhancements are underway to create new mixed-use job centres that will bring good jobs closer to home, and vibrant places to work, live and play. Attendees at the event will be able to get a glimpse of the enhancements in the parks, that will include enhanced greenery and streetscape. These efforts will go a long way towards maintaining a vibrant manufacturing landscape, and attracting young talents to work in manufacturing.

Students will get to experience AI technologies first-hand through an "escape-room" challenge concept.

PROGRAMME

9:00am - 10:30am:	Plant Tour (Open House) of UMC, SSMC, Jabil, Soitec, Siltronic, AMS - Poly/ITE students
10:30am:	Tour of Exhibitions/Fringe Activities - Poly/ITE students
11.30am:	Registration
12.00pm:	Speech by GOH - Mr Chee Hong Tat, Senior Minister of State, Ministry of Trade and Industry & Ministry of Education
12.30pm :	Tour of Exhibitions/Fringe Activities - Uni students
1.30pm - 3:00pm :	Plant Tour (Open House) of UMC, SSMC, Jabil, Soitec, Siltronic, AMS - Uni students
3.00pm :	End

FRINGE ACTIVITIES:

Autonomous Vehicle

Lab on Wheels (by IMDA)

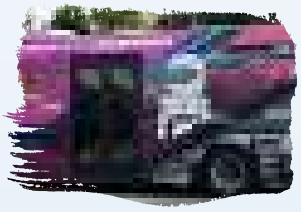

Photo Booth

Drone Challenge

HPE/NVIDIA DEEP LEARNING WORKSHOP FOR INDUSTRIAL INSPECTION

"Quality is never an accident, it is always the result of intelligent efforts," said John Ruskin almost 200 years ago, but it holds true even today. High tech manufacturers are most concerned about quality of their products and continue to look for innovative ways to improve quality through the production process. Improving quality is challenging when it relies on manual inspection or traditional rule-based visual inspection. ASQ estimates that cost of quality is about 15-20% of cost of overall operations. To address this, automating defect inspection with artificial intelligence (AI) is beginning to revolutionize manufacturing. Deep learning (DL), especially convolutional neural networks (CNN), have proven to be very effective for image detection and classification, and is now being adopted to solve industrial inspection tasks.

Hewlett Packard Enterprise and NVIDIA are leading solution providers for industrial inspection leveraging our leadership in High Performance Computing and GPUs. They will present a two-day workshop focused on building quality inspection deep learning model, introduction to AI ecosystem and share customer case studies free of cost (first come first serve basis). Lunch and refreshments will be also provided.

What kind of industries can benefit from this approach?

- High tech manufacturing
- Semiconductor front end & back end
- Electronics component manufacturers
- Precision engineering
- Aerospace components manufacturing

Upon completion of this training, participants will be able to design, train, test, and deploy building blocks of a hardware-accelerated industrial inspection pipeline and obtain key learnings from customer case studies.

DATE / TIME	AGENDA	AUDIENCE	PRE-REQUISITES
Thursday Nov 14, 2019 (9am – 5pm)	Deep learning for Industrial Inspection	Developers Data scientists (Max 20 pax)	Experience with Python and convolutional neural networks (CNNs)*
Thursday Nov 15, 2019 (9am – 12noon)	Introduction to AI partner ecosystem – Customer case studies	Developers Data scientists Team managers (Max 40 pax)	None
Friday Nov 15, 2019 (1pm – 5pm)	Training on NVIDIA RAPIDS using HPE High Performance Computing Platform	Developers Data scientists (Max 20 pax)	Experience with Python and convolutional neural networks (CNNs)*

Prerequisites: Familiarity with deep neural networks, experience with Python and deep learning frameworks such as TensorFlow, Keras, or PyTorch Tools and Frameworks used during the course: TensorFlow, TensorRT, Keras

EPTC 2019

The 21st Electronics Packaging Technology Conference (EPTC 2019) is an International event organized by the IEEE RS/EPS/EDS Singapore Chapter and sponsored by IEEE Electronics Packaging Society (EPS). EPTC 2019 will feature keynotes, panel sessions, Invited talks, technical sessions, short courses, forums, an exhibition, social and networking activities. Since its inauguration in 1997, EPTC has developed into a highly reputed electronics packaging conference in the Asia-Pacific and is well attended by experts in all aspects of packaging technology from all over the world. EPTC is the flagship conference of IEEE EPS in Region 10. SSIA is honoured to be the Association Partner of the event.

The idea for EPTC was mooted by the IEEE Singapore Joint Rel/CPMT/ED Chapter towards the end of 1995. It was felt that there was no Society-sponsored, ECTC-like electronics packaging conference in Asia at that time. It was thought that the great distance between USA and Asia and the expenses involved were preventing many packaging engineers from Asia to attend ECTC. It was then decided to organize an international electronics packaging conference to provide a platform for packaging engineers from all over the world but especially in the Asian region, to exchange ideas and share experiences.

EPTC 2019 Date: December 4-6, 2019 Venue: Marina Bay Sands Registration: www.eptc-ieee.net

SSIA

What are the Benefits of SSIA membership?

Business networking opportunities

Knowledge sharing platform with government agencies

Extensive market outreach and branding opportunities

Leadership and master class trainings

Priority access to industry benchmark data and directories

Priority in customised talent outreach programmes

To connect with us
visit https://ssia.org.sg

For more information about membership
visit https://ssia.org.sg/join-us/

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sme

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pme centre

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FairPrice Unity

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on your groceries, health & wellness products and services

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Up to $40,000* Group Insurance Coverage

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