

MANUFACTURING MATTERS

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FEATURE FOR INDUSTRY TO BE FUTURE-READY

SKILLS MATTERS
**SKILLS UPGRADING AMIDST
DISRUPTIONS**

SUSTAINABILITY MATTERS
FOOD WASTE MANAGEMENT

RESEARCH SPOTLIGHT
**COATED IMPLANTS:
A BREAKTHROUGH IN BONE
HEALING**

NOTE FROM EDITOR...

Dear Industry Partners,

The fourth industrial revolution journey, i4.0 (Industry 4.0) is taking root globally. Comprising smart automation and continuous data exchange in manufacturing technologies, i4.0 includes cyber physical systems, Internet of things (IoT), cloud computing, big data analytics, robotics, augmented reality, smart manufacturing, digital factories and etc. These game-changing innovative technologies help to transform industries to be more intelligent, efficient and sustainable.

As Singapore's industries continue to face unprecedented challenges, it is timely to actively explore i4.0 for industry transformation and to open up new opportunities for business innovation. Small and Medium Enterprises from various industries have initiated this migration with A*STAR's Singapore Institute of Manufacturing Technology (SIMTech) to adopt i4.0 technologies in their operations. These SMEs are rewarded with benefits from their initiation (see Feature for details).

To accelerate its outreach to more industries, the model factory@SIMTech is launched to help companies gear towards i4.0. This facility showcases and demonstrates i4.0 technologies, providing a learning environment for companies to experiment and experience Manufacturing Control Tower™(MCT™) technologies (see Feature for details).

Embark to understand and participate in the 4th industrial revolution journey today.

Swee Heng

Editor, Manufacturing Matters

Email: shlee@SIMTech.a-star.edu.sg



FOR INDUSTRY TO BE FUTURE-READY

The model factory@SIMTech showcases and demonstrates i4.0 (Industry 4.0) technologies, providing a Learning Factory environment for companies to experiment and experience Manufacturing Control Tower™(MCT™) technologies

Singapore's manufacturing sector, a key GDP contributor to the economy, is undergoing disruptive challenges. To assist industry, the model factory@SIMTech, at Synthesis Tower of Fusionopolis Two, aims to create awareness and accelerate the adoption of SIMTech's advanced manufacturing technologies, known collectively as Manufacturing Control Tower™ (MCT™) technologies.

About model factory@SIMTech

A key feature of the model factory@SIMTech is a live pilot-scale production line that allows companies to gain **hands-on experience of advanced manufacturing technologies, prior to adoption**. Within the model factory, MCT™ technologies capture, consolidate and analyse real-time data which are displayed in a dashboard to view all information at a glance for informed and timely business decisions. Smarter management of companies' manufacturing operations is achieved through a platform that is easily accessible via simple mobile apps. Companies interested in adoption can also test the solutions in this production line before implementation.

The model factory line also provides an **immersive learning environment**. Classes will be organised around live demonstrations to upgrade manufacturing workforce with relevant i4.0 skills.

SIMTech will work with technology partners to **explore and co-create new technologies**, using the model factory as a test bed. The collaboration can be in the form of industry joint labs or multi-disciplinary research teams.



Pilot Tests and Adoptions

Several companies have adopted SIMTech's MCT™ platform to pilot test or adopt the various new digital manufacturing technologies. With the MCT™ platform, companies can pick and choose the appropriate technologies to meet their needs.

CKE Manufacturing Pte Ltd, specialising in precision engineered components since 1946 for industries ranging from aerospace to marine, is a test-bed partner in **App-enabled product quality monitoring and management system** in its actual production lines.

The App is a front-end easy-to-understand tool for the visualisation production manager to have visibility on most recent and historical product quality data. This system automates the quality measurement data collection and generate inspection report. It collects inspection data during in-

“As a SME, it is clear to me that if we don't adopt advanced manufacturing technologies, we won't survive”

Mr Li Feng Kwan, Director
CKE Manufacturing Pte Ltd

coming, in-process and out-going quality inspection process in real-time, consolidates and provides an overview of the production quality performance status with real-time alerts. The system also provides data correlation analysis to improve quality.

With a quality monitoring and management system to automate quality measurement data collection, recording, monitoring and analysis processes, CKE Manufacturing reduces quality track and trace efforts by 50 – 80 per cent, error recovery decreases by 20 – 30 per cent without manual entry mistakes; reduces customer quality report generating time by 50-80 per cent and increases response time of quality detection by 30-50 per cent.

LHT Holdings Limited, a publicly listed company in the timber industry for more than 30 years, test piloted the **Energy Efficiency Monitoring and Analysis System (E²MAS)** that assesses its equipment's energy efficiency in real-time and identify hot spots of excessive energy usage. Analysing the hotspots to derive quantifiable energy improvement potentials allows LHT to understand day-to-day energy usage of its manufacturing processes and embed best practices in energy management. Power meters have been installed at the pallet assembly and polishing machines. Energy anomalies are detected while energy efficiency gaps are quantified.

As a mobile application, E²MAS shows the real-time capability of energy efficiency monitoring and analysis. Reference days with the respective operating conditions are provided as guidance on achieving the best.

Feinmetall Singapore, a local precision engineering SME that specialises in the design and manufacturing of probe cards for semiconductor tests since 2007, recently adopted MCT™ technologies at its new \$6 million, 6,700 sq ft digital manufacturing facility. The **MCT™ Dashboard**, comprising multiple screens housed within a control room, consolidates information, providing overall visibility of operations in real-time.



Impetus Conceptus, a confi-document shredding and recycling management company, adopted a combination of **Vehicle Routing solution**, one of the MCT™ technologies for other stages of the manufacturing value chain, and smart waste management. The solution can automatically create pick-up schedules for drivers, as well as re-schedule accordingly in response to changes in demand. It is expected to help Impetus improve waste collection assets utilisation and manpower by up to 35 per cent.

“With E²MAS, LHT can reduce energy consumption by 20 per cent on average”

Ms May Yap, Managing Director
LHT Holdings Limited

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GAINING COMPETITIVE ADVANTAGE WITH T-UP

The T-Up of a SIMTech research engineer led Micro-Mechanics Ltd to explore the first-of-its-kind interface morphology to value-add its pick-up tools. In many industries, although joining between the elastomeric material and substrate is required in their application, such adhesion encounters a process shortfall in the highly precise pick-and-place system used in the semiconductor industry.

Micro-Mechanics designs, manufactures and markets high precision parts and tools used in the process-critical applications for the semiconductor and other high technology industries. The SIMTech engineer, who was attached to Micro-Mechanics, and its R&D team made use of existing company facilities to design and fabricate the interface morphology. The team successfully proved the concept of surface morphology is able to reduce the interface adhesion significantly. This innovation is the answer to its current customers' application difficulty, and optimising its existing processes.

Many customers gave positive feedback and would like to order more of such tools for highly sensitive components that have inherent lower productivity due to interface adhesion.

“ This T-Up has provided us an upper hand by addressing effectively the intricate interface adhesion issue faced by industry ”

Mr Low Ming Wah, President, Chief Operating Officer and Executive Director of Micro-Mechanics Holdings Ltd

*Note: The T-Up initiative, a multi-agency effort by A*STAR, the Economic Development Board, SPRING Singapore, IE Singapore and the then Infocomm Development Authority, involves seconding RSEs to local enterprises to enable them to access the pool of R&D talent in the Research Institutes.*

For more information, please contact **Mr Cedric Yon** at xyyon@SIMTech.a-star.edu.sg

EXPANDING SYSTEMATICALLY WITH OTR

An Operations and Technology Roadmap (OTR) was facilitated by SIMTech for Whitford Singapore Pte Ltd a manufacturer of coatings for the cookware, automotive and industrial lubricity and anti-corrosion markets in Singapore and Asia, established a strategic roadmap on Zinc-rich anti-corrosion coatings. The findings of the roadmap for automotives, including the development of new manufacturing processes, creation of pilot batches for overseas markets and securing TS16949, an ISO specification, and factory scale-up. Laboratory capabilities were also upgraded.

In scaling up its production, Whitford Singapore implemented process control equipment that is linked to the Enterprise Resource Planning systems as part of its Industry 4.0 initiative. A robotics project to automate the factory line was also started. Whitford Singapore engaged SIMTech in an Electronic Impedance Spectroscopy project to accelerate their development process for the coatings.

“ The OTR and planning process gave us good credibility when presenting the case to Whitford Headquarters ”

Mr Steve Barron, Managing Director, Whitford Singapore Pte Ltd

To implement these initiatives, Whitford Singapore hired a research chemist, two sales staff and appointed an agent to spearhead the Zinc-rich product line. When these new initiatives bear fruit, Whitford Singapore's projected revenues are on track for FY2022.

“ OTR's systematic approach helped us focus and gather our resources to start the first of its kind Zinc-rich project for Whitford Singapore ”

Mr Jeffrey Foong, Chief Financial Officer, Whitford Singapore Pte Ltd

For more information, please contact **Mr Jeffrey Pan** at sppan@SIMTech.a-star.edu.sg



SKILLS UPGRADING AMIDST DISRUPTIONS

New training initiatives and programmes in place to meet industry needs

As digital manufacturing gains momentum, robotics and automation, 3D printing, data analytics, are becoming the norms and practices, disrupting and redefining production activities, job functions, as well as the global economic growth. New skill sets or capabilities are required to apply innovative technology or techniques in the complex or changing manufacturing environment. SIMTech, in partnership with Skills Future Singapore (SSG), has aligned its training programmes to SkillsFuture framework. Our course structure and training delivery model will be restructured by establishing Learning Labs or model factory@SIMTech to create a vibrant, relevant hands-on learning environment. On-site learning at workplace is one of the emphasis, introducing an e-Learning system enables learning to be done anytime, anywhere.

To date, SIMTech-SSG launched 22 WSQ training programmes, trained more than 3,700 PMETs and awarded over 6,000 Statement of Attainments. More than 1,000 local companies across various manufacturing sectors have benefited. Close to 70 per cent of these are Small and Medium Enterprises (SMEs) in which many have sent their employees repeatedly for skills upgrading and learning.

To complement the WSQ training programmes, over 10 SSG Master Classes were conducted by internationally renowned experts. More than 300 participants have attended. These Master Classes deepen participants' expertise and broaden their knowledge on emerging innovative technologies to capture new business opportunities.

As local manufacturing shifts to advanced manufacturing activities, the demand for manufacturing R&D engineers increases correspondingly. With the support from SSG, SIMTech launched the Manufacturing R&D Certificate (MRDC) Programme in 2015 to address gaps in equipping fresh graduates with industrial R&D experience and skills. 15 MRDC graduates, who completed their two-year programme, are ready for deployment to the manufacturing industry.

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BREAKING INTO HIGH GROWTH INDUSTRY WITH 3D ADDITIVE MANUFACTURING

Transfer 3D AM capabilities to home-grown company

Home-grown 3D Matters, a local 3D printing service bureau, is richly rewarded when it participated in the Collaborative Industry Project (CIP) on AM between SIMTech and 5 companies. Through the CIP, 3D Matters acquired capabilities in Selective Laser Melting (SLM) technology for 3D metal printing, and successfully expanded its capabilities beyond polymer printing to 3D metal printing. This led to the set-up of 3D Matters' sister company, 3D Metalforge, specialising in 3D metal printing services.

3D Metalforge is continuing to pursue innovation through the establishment of the Additive Manufacturing Centre (AMC). Focusing on low-cost and fully-certified innovative metal AM technologies, it enables 3D Metalforge to shift from prototyping to producing industrial-grade end-use parts for the Marine & Offshore, Oil & Gas and Precision Engineering (PE) sectors. With its fully digitised workflow from

design to testing, 3D Metalforge is able to provide decentralised 3D metal printing and post-processing services. Core R&D, design optimisation, and digital file creation activities will be retained in Singapore, while production can be performed locally or overseas, supporting the company's overseas expansion plans.

Happy with the value creation from the CIP, 3D Matters and SIMTech further strengthened the collaboration through the development of Laser Aided Additive Manufacturing (LAAM) technology for large format 3D printing to produce industrial-grade metal parts that are larger in shorter production times. With this, 3D Metalforge can leverage LAAM technology to further unlock opportunities in the Marine & Offshore, Oil & Gas and PE sectors, where such large industrial-sized metal parts are currently sourced from overseas vendors.

“ The LAAM technology will be a gamechanger for industry. We will be able to produce high quality, large format, cost effective metal parts with unsurpassed mechanical properties ”

Mr Matthew Waterhouse, Chief Executive Officer, 3D Metalforge

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CREATING THE VALUE CHAIN OF PRINTED ELECTRONICS

Printed electronics capabilities development for SMEs

Printed electronics are printing methods used to deposit electrically functional electronic or optical inks on substrates to create active or passive devices. The printed electronics market is expected to reach US\$ 12.1B by 2022 at a Compound Annual Growth Rate of 22 per cent between 2017 and 2022. Internet of Things is the prime driver for printed electronics. Its low cost, thin-form, flexibility, stretchability, portability, and rollability facilitates applications in wearable devices, smart packaging, healthcare, automotive, flexible displays, decorative and animated posters, etc. (Source: MarketsandMarkets 2016).

For the Singapore manufacturing industry to tap the growing printed electronics market, SIMTech partnered equipment development and material development SMEs to develop capabilities. The experiences of these companies are highlighted.

Speise Tech

In this project with a specialist in custom-made equipment for Factory Automation, a high accuracy registration module with registration

“ I had been working with SIMTech for nearly 12 years in product and process development. With the experience gathered from both the industry and SIMTech, we are able to develop more technologies to grow the company. In 2016, SpeiseTech (Thailand) Co. Ltd was founded ”

Mr Michael Woo, Engineering Director, Speise Tech Pte Ltd

error of less than 50µm for layer-to-layer various printing, coating of printed electronics applications is developed. The registration module is also integrated into 300mm roll-to-roll line for two-layer printed patterns on polymer films and multi-layered coating and printing. This collaboration helps Speise Tech to develop roll-to-roll equipment product line for the emerging printed electronics industry in Singapore.

Quantum Chemical Technologies

SIMTech collaborated with Quantum, a manufacturer and distributor of high quality solder products and related soldering chemicals, to develop and upscale silver nanowire (AgNWs) production for transparent conductive film (TCF). The upscaling process yields

good quality nanowires that gives a high optical transmittance and low sheet resistance transparent conductive films.

More importantly, these partnerships pave the ecosystem for roll-to-roll equipment manufacturing and material development in printed electronics locally.

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EAC Emerging Applications Centre
 Seeding and Growing Emerging Industries



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FOOD WASTE MANAGEMENT

Tackling food waste in Singapore's F&B industry using SIMTech-developed methodology

About 791 million kg of food waste was generated in Singapore in 2016. This works out to about 140 kg of food wasted per person. Of this amount, only 13 per cent is recycled with the rest being incinerated at the waste-to-energy (WTE) plants. Due to the high moisture content, the energy recovered from food waste via incineration is both inefficient and unsustainable.

To tackle this problem, SIMTech collaborated with the Singapore Food Manufacturers' Association (SFMA) and led a working group, comprising stakeholders from industry, academia and government agencies, to develop the Singapore Standards for Food Waste Management for Food Manufacturers and Retailers. Underlying these standards is a SIMTech-developed methodology that enables companies in the F&B industry to reduce food waste and recover value through alternative uses. The methodology provides a systematic way for companies to conduct food waste audit in their premises to identify food waste generation hotspots, find out the main causes, and develop appropriate initiatives to reduce or recover value from food waste.

Working together with various stakeholders in the food waste value chain, SIMTech is pilot-testing the

methodology at the central kitchen of one of Singapore's biggest F&B company. A system has been successfully implemented at the company to collect and analyse the data on food waste generated in their operations. It can now track the food waste generated by different product categories as well as the individual processes. Based on the tracking results, the company plans to develop initiatives with SIMTech's assistance to progressively reduce the amount of food waste generated, and recover this for other uses.

With the introduction of the Singapore Standards for Food Waste Management for Food Manufacturers and Retailers by end 2017, industry's adoption of the methodology not only alleviates the food waste problem in Singapore, but also helps F&B companies to save on raw materials and waste disposal costs. The utility of the food waste management methodology will be

extended to, and pilot-tested at hotels, restaurants and food courts.

“ **The Standard for Food Waste Management will help Singapore to prolong the life of waste land filled areas and improve the practices and competitiveness of food companies through more efficient use of food resources in their processes. The potential to enhance productivity improvement through food material saving, waste reduction and saving in waste collection and disposal costs can be very significant** ”

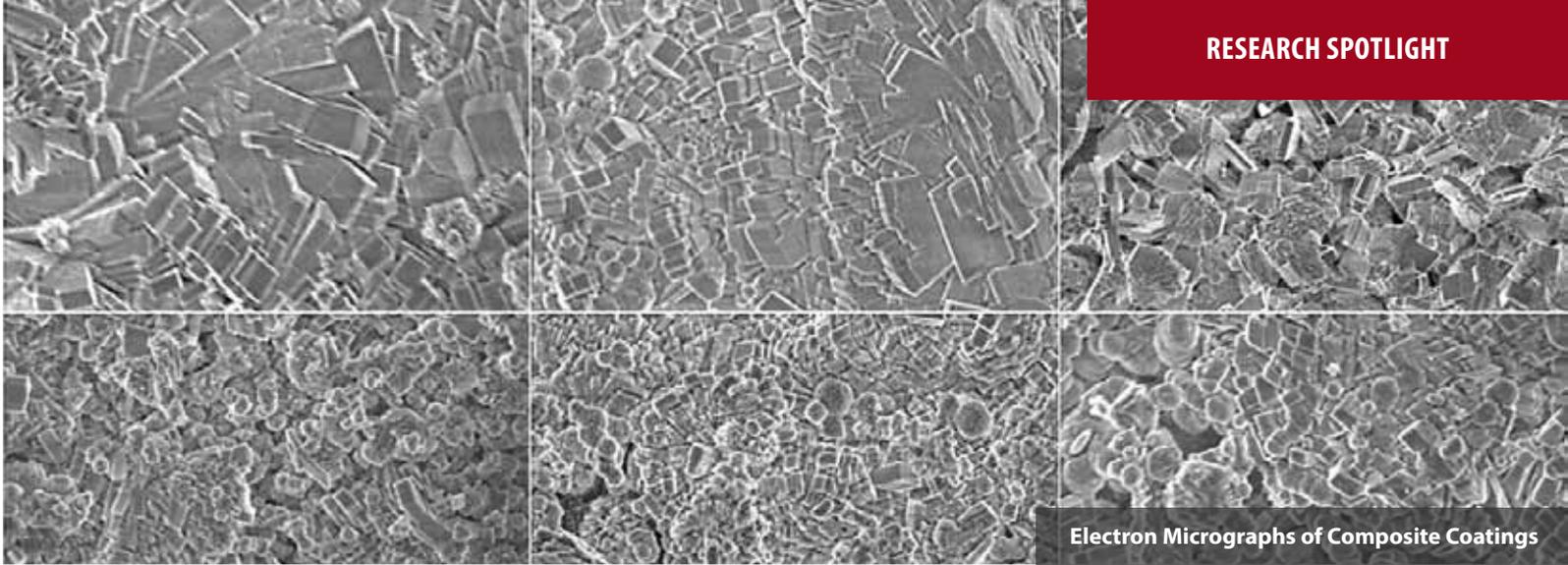
Mr Wong Mong Hong, Immediate Past President, Singapore Food Manufacturers' Association

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Electron Micrographs of Composite Coatings

COATED IMPLANTS: A BREAKTHROUGH IN BONE HEALING

Broken bones may be repaired more effectively by using a biodegradable coating for magnesium-based metals implants

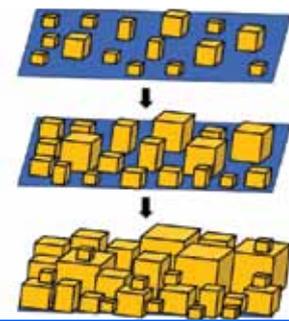
Some bone fractures require a temporary metal implant for support during healing. However currently used implants, such as screws and braces made of titanium, steel or cobalt-chromium alloys, have serious drawbacks. The difference in mechanical properties between these metals and the healing bone can loosen the implants and damage the bone. In addition, the temporary implants must eventually be surgically removed, resulting in further risk and inconvenience.



Comparison between bare (left) and coated (right) magnesium samples after 28 days immersion in simulated body fluid solution indicating severe corrosion and pitting of the unprotected metal while only moderated corrosion is seen on the coated part

SIMTech is developing a technology for making biodegradable implant with magnesium core which has better mechanical match with bones. Magnesium is a strong and flexible metal but its reactivity does not allow it to be used on its own as it would corrode too quickly inside the body. To turn the corrosion tendency into an advantage, the rate of degradation must be controlled. A challenge is to find a coating that degrades slowly enough to allow the metal to support the bones during healing, then safely dissolves when the job is done.

SIMTech collaborated with Professor Tan Ming Jen of Nanyang Technological University to explore potential coatings. Calcium phosphate is selected as this inorganic material is a key natural component of bone. Incorporating organic polymers produced a composite coating with several key advantages. Varying the mix of components allows the mechanical and biodegradable properties to be adjusted for different requirements and avoids the brittleness of purely inorganic coatings. Studies with cell cultures suggest the calcium phosphate might also actively assist the healing process by providing some raw



Conceptual coating deposition by growing crystals on the metal surface. The crystals can grow in several layers and fully cover the metal to seal it off from the corrosive environment

materials to sustain bone growth. The magnesium is coated from a solution of pressurised hot water in a one-step process, offering a simplicity that may be crucial for commercial-scale production.

The researchers are also exploring options to make the coating even more useful by incorporating antibiotics and other drugs that could permeate the surrounding tissues and bone, contributing to healing.

For more information, please contact
Dr Nemeth Sandor, Principal Research
Engineer at sandorn@SIMTech.a-star.edu.sg

“Animal trials are an obvious next step, but would require an industry partner”

Dr Nemeth Sandor, Principal Research Engineer,
SIMTech

A number of events were organised in 2017 to engage the industry and forge partnerships

SIMTech Annual Manufacturing Forum (AMF) 2017, 27 July

SIMTech flagship conference was participated by more than 400 attendees from industry, associations, government agencies and institutes of higher learning. With the theme, Innovating with Flexible Hybrid Electronics (FHE), the 12th SIMTech AMF' 17 captures innovations and business opportunities. Technology leaders and experts in FHE converged to share global industry trends and developments that drive the industry. The Employment and Employability Institute is the partner of this event in collaboration with the Print and Media Association, SEMI Singapore, Singapore Precision Engineering and Technology Association as well as SPRING Singapore.

Dr Harri Kopola, Professor in Knowledge Intensive Products and Services (KIPS), Business Area VTT Technical Research Centre of Finland Ltd, delivered the Annual Manufacturing Lecture on Flexible Printed Hybrid Electronics from Technology towards Applications and Products. Dr Khasha Ghaffarzadeh, Research Director IDTechEx, UK shared the Three Major Technology Trends in Flexible (Printed) Hybrid Electronics.

Session Keynote on Printed Sensors Technology: Design, Manufacturing Process and Applications was presented by Dr Sören Fricke, Section Head, CSEM, Switzerland. Mr Girish Wable, Manager, Strategic Capabilities, Jabil, USA gave an insight on Flexible Hybrid Electronics Architecture Opportunities and Challenges in IoT Ecosystems in the other Session Keynote. The event was complemented by an exhibition participated by companies and government agencies.



SIMTech-SSG PE WSQ Graduation Ceremony, 16 August

537 graduands from 17 WSQ training programmes who have successfully completed their respective SIMTech-SkillsFuture Singapore (SSG) Precision Engineering (PE) Workforce Skills Qualifications (WSQ) Programmes and the Manufacturing R&D Certificate Programme celebrated their graduation. Dr Gog Soon Joo, Group Director and Chief Research Officer, SkillsFuture Singapore (SSG), graced the occasion.

Winners of this year's Most Inspiring Trainee Award are Ms Liang Sopen, Human Resource Manager, The Craftmark Group; Mr Tham Weng Fatt, Joseph, Director of Engineering, Carlton Hotel Singapore and Mr Ng Tiong Chye, Manufacturing Engineer, Hewlett Packard Enterprise Singapore Pte Ltd. The Best Industry Partner Award goes to Mr Pek Yew-Chai, Director, Pirtek Asia Pte Ltd; Mr Yeh Bao Say, Managing Director, Vento Systems Pte Ltd and Mr Jackie Lau, Managing Director, Seng Heng Engineering Pte Ltd.



EAC Annual Conference 2017, 19 September



Prominent industry leaders and academic experts shared their insights on technology development and commercialisation opportunities in microfluidics, in Building Microfluidics Eco-system for Singapore Industry. An array of microfluidics technologies, services, products and related businesses as well as competencies of SIMTech Microfluidics Foundry (SMF) was showcased at the event.

Topics covered at the conference include the outlook of microfluidics and diagnostics market. To See the World in the Grains of iSAND* was presented by Professor Luke P Lee, Director, Biomedical Institute for Global Health Research & Technology (BIGHEART), NUSEP Precision Engineering Pte Ltd. SIMTech's Journey in Microfluidics R&D was shared by Dr Wang Zhiping Director, Emerging Applications Division, SIMTech. The Status of Microfluidics Industry was provided by Dr Benjamin Roussel, Business Unit Manager, Yole Développement. A preview on BD Diagnostic Systems - Microfluidic Applications was presented by Dr Karin E Blume, Senior Scientist, Becton Dickinson. An insight of Superfast Genetic Testing in 5 minutes was given by Dr Thomas Gong, CEO of Star Array.

Collaborative Industry Projects (CIPs) are cost-effective platforms, where companies facing similar issues work jointly with SIMTech, to develop capabilities and technology

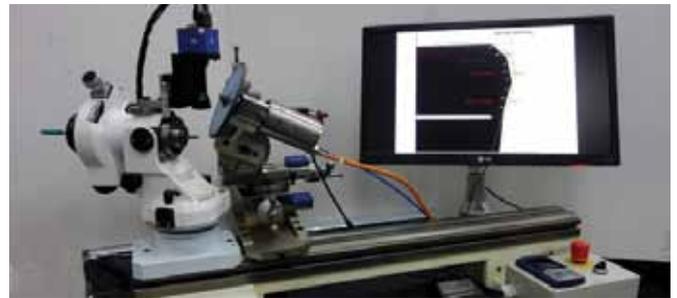


3D Marking and Surface Engraving for Medical Devices

Call for Participation

This CIP aims to demonstrate 3D laser marking and surface feature engraving on complex surfaces with various base materials for medical devices.

For enquiries, please contact **Mr John Lim** at kylim@SIMTech.a-star.edu.sg



Customised Tool Grinding, Edge Finishing & In-Situ Measurement

Call for Participation

This CIP aims to enhance the effectiveness of local companies in interrupted cutting and high aspect boring of corrosion resistant alloys with innovative integrated grinding, polishing and in-situ measurement of high performance carbide tooling, drills and inserts.

For enquiries, please contact **Dr Lim Beng Siong** at bslim@SIMTech.a-star.edu.sg



“ I appreciate the well thought-out structure of the course, which mixes profound theoretical topics with hands-on applications, making it easy to see the benefits of systematic data analysis ”

Dr Frank Hoewing, Head of the Centre of Competence, in-tech GmbH

Master Class – Energy Efficient Factory Enabled by Industry 4.0 Technologies

9 - 10 October 2017

Call for Participation

Based on the highly successful 40-hour “DieLernfabrik” (Learning Factory) course in TU Braunschweig, Germany, a distilled version retaining its essence into a 2-day Master Class just for you is the first of its kind tailored for the Singapore industry.

Delivered by the highly engaging Principal Instructor, Professor Christoph Herrmann, an expert in Energy Management, and assisted with a team of energy efficiency experts from Germany and SIMTech, the Master Class promises a high impact learning experience in realistic contexts in a unique, immersive learning environment at the model factory@SIMTech.

This master class is designed for Chief Sustainability Officers, Senior Management in the facilities and operation management, energy efficiency initiative leaders, Singapore Certified Energy Managers.

Course Fee: S\$500, for Singaporean and PRs (after funding from WSG); \$1,800 for others

Master Class Info & Registration link:

goo.gl/Fk9H5Z

For enquiries, please contact **Mr Lee Hock Wee** at hwlee@SIMTech.a-star.edu.sg

SIMTech Sustainable Manufacturing Centre Annual Conference 2017

2 November 2017 | 8.30am - 5.00pm | Devan Nair Institute for Employment and Employability, Hall 1-3

Waste Revival in Manufacturing – Technology, Practice and Impact is the theme of the conference, featuring keynote presentations by Professor Sami Kara of the University of New South Wales on Waste Revival from a Life-Cycle Perspective, and Mr Johnpaul Dimech, Asia Pacific & Country Chair of Sodexo on Industry Trends and Development in Food Waste Management.

There will be a post-conference Master Class on Life Cycle Engineering on 3 November, 2017. Both events are not chargeable. For registration, please visit <https://www.a-star.edu.sg/SIMTech-smc/Events/Nov-2017.aspx>

For enquiries, please contact **Mr Lee Hock Wee** at hwlee@SIMTech.a-star.edu.sg



Scan for more events

Master Class in Energy Efficient Factory Enabled by Industry 4.0 Technologies

9 - 10 October 2017 | 8.30am - 5.30pm, Synthesis

*Refer to page 11 for details

PE WSQ Implement LEAN Manufacturing (Batch 23)

13 October 2017 | 9.00am - 1.00pm, IDV

PE WSQ Programme in Integrated Carbon Footprint Assessment Reporting Essentials

16 October 2017 | 9am – 6pm, Fusionopolis Two

PE WSQ Graduate Diploma in MedTech Manufacturing Module 2: MedTech Manufacturing and Quality System

16 October 2017 | 6.30pm - 9.30pm, Fusionopolis Two

PE WSQ Graduate Diploma in Advanced Welding Technologies

Module 3: Review Welding Operation & Quality Control

31 October 2017 | 6.30pm - 9.30pm, Fusionopolis 2

Master Class on Life Cycle Engineering

3 November 2017 | 5.30pm, Fusionopolis 2

Post-Sustainable Manufacturing Centre Annual Conference 2017 Master Class Life Cycle Engineering

Design Optimisation for Additive Manufacturing

3 November 2017 | 5.30pm, Fusionopolis 2

Master Class in Emerging Manufacturing Technologies

Design Optimisation for Additive Manufacturing

7 - 9 November 2017 | 8.30am - 5.30pm, NTU Valley Block

Master Class in Predictive Manufacturing and Services

Supply Chain Analytics – Descriptive, Predictive & Prescriptive Analytics

14 - 15 November 2017 | 8.30am - 5.30pm, Fusionopolis Two

Master Class in Strategic Planning for Operational Excellence

Mastering Sales and Operations Planning (S&OP) Process to Align Strategies for Operational Excellence

16 - 17 November 2017 | 8.30am - 5.30pm, Fusionopolis Two

For course details and registration, please visit <http://kto.SIMTech.a-star.edu.sg>

For general enquiries, please contact

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About SIMTech

The Singapore Institute of Manufacturing Technology (SIMTech) develops high-value manufacturing technology and human capital to enhance the competitiveness of Singapore's manufacturing industry. It collaborates with multinational and local companies in the precision engineering, medtech, aerospace, automotive, marine, oil & gas, electronics, semiconductor, logistics, and other sectors.

SIMTech is a research institute of the Agency for Science, Technology and Research (A*STAR). With a pool of more than 400 researchers, we are committed to serving the manufacturing industry to develop the human, intellectual, and industrial capital in Singapore.

