ITRI TODAY

106

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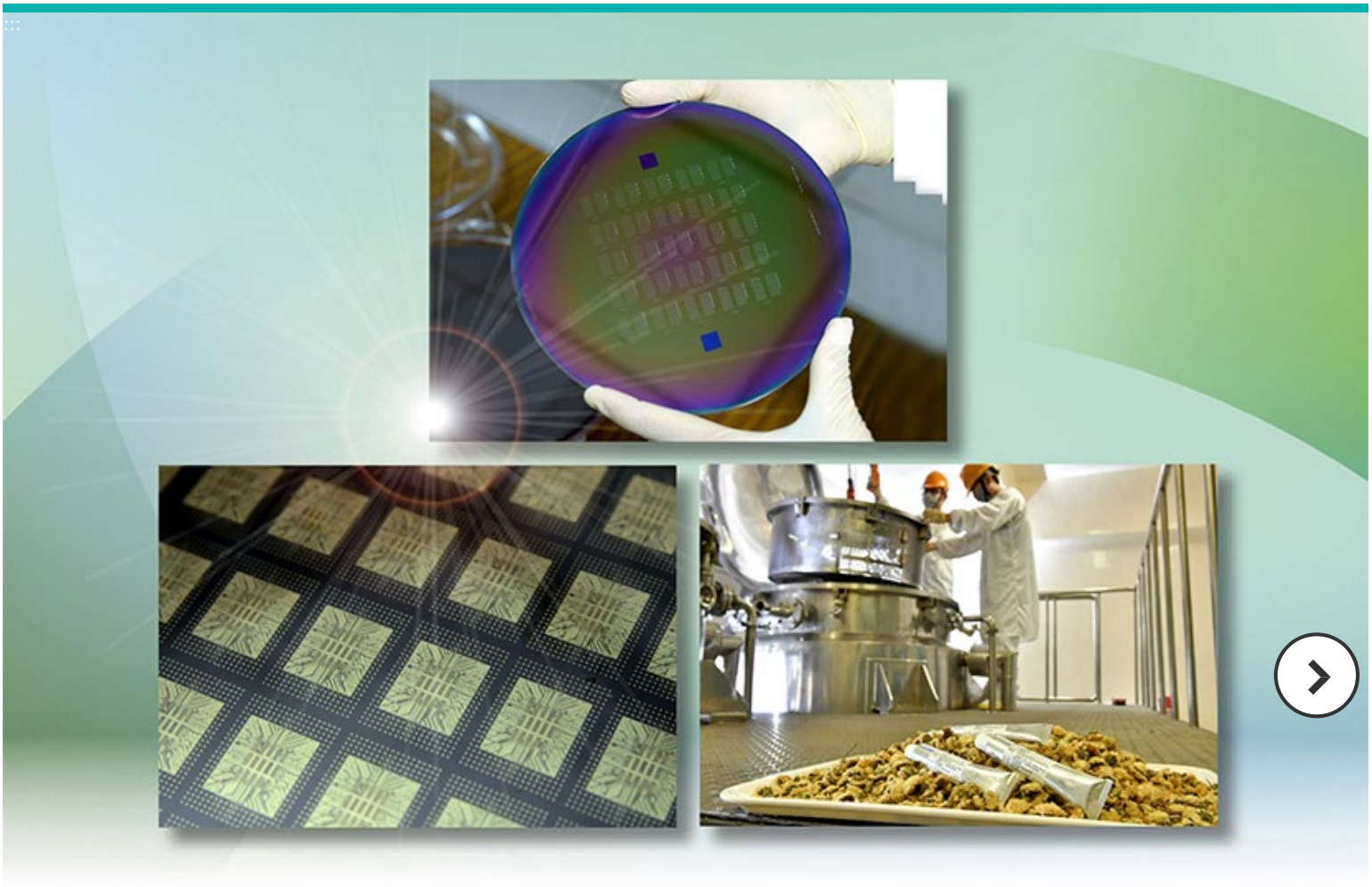

ITRI Celebrates 48th Birthday: Researchers Honored for Outstanding Performance

ITRI held its 48th anniversary celebration online, where the ITRI Elite Awards were presented to outstanding staff for excellent performance in R&D and industry services.

ITRI
Industrial Technology Research Institute

ITRI Today is a quarterly publication reporting major events and achievements at ITRI.

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ITRI Celebrates 48th Anniversary Online and Honors ITRI Elites

Video of ITRI's 48th Anniversary.

Due to the current COVID-19 restrictions in Taiwan, ITRI held its 48th anniversary celebration ceremony online in early July. It is the first time that the Institute has celebrated its anniversary virtually. Thousands of employees participated via live streaming and ITRI Elite Awards were presented online to outstanding staff for their excellent performance in R&D activities and services.

During the virtual event, Minister of Economic Affairs Mei-Hua Wang praised ITRI as an important promoter of industrial innovation, stating that the Ministry will continue to support ITRI's innovation-oriented tech R&D and industrial upgrading, thereby enhancing Taiwan's national competitiveness.

ITRI President Edwin Liu encouraged ITRI colleagues to seize post-pandemic opportunities associated with a shake-up in industrial supply chains, using innovative and forward-looking

technologies to strengthen the resilience of Taiwan industry, enhance its competitiveness, and embrace the new challenges of 2050, reaffirming ITRI's commitment to achieving net zero emissions.

The online anniversary celebration also recognized the ITRI Elites, including honorees for Outstanding Research Award and Industry Contribution Award. This issue of ITRI Today will reveal these innovations in the Feature and R&D Focus sections.

Read about gold medal winners for the Outstanding Research Award below:

- Non-steroidal Anti-psoriatic Botanical Drug PTB323X
- Phased Array Variable Frequency Microwave Technology
- High Aspect Ratio Glass Substrate Hole Plating and Inspection Technology

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» Feature

Non-Steroidal Anti-Psoriatic Botanical Drug PTB323X

Psoriasis is an autoimmune disease which affects 2-3% of the world's population and can cause chronic inflammatory skin lesions. When the disease is severe, patients may lose their ability to function in everyday life. The most common drug treatment for psoriasis involves the use of steroids; however, long-term steroid use can be a burden on the human body.

Animal study shows non-steroidal botanical psoriasis drug PTB323X developed by ITRI can effectively improve psoriasis-like skin inflammation without causing skin-related side effects. This new drug was developed via ITRI's botanical drug technology platform, including the technologies to study medicinal materials, efficacy, toxicology and pharmacokinetics.

Researchers of the non-steroidal botanical psoriasis drug PTB323X.

According to Dr. I-Hong Pan, Division Director of ITRI's Biomedical Technology and Device

Research Laboratories, ITRI utilized three technologies for the botanical drug technology platform to make a breakthrough in the production of this non-steroidal botanical drug. First, medical ingredient content multiplication technology was employed to increase the amount of pharmaceutical ingredients in the plants by 40 times; second, biotransformation and purification technology via enzymes and process optimization increased the purity by 72 times; and third, active ratio technology for pharmaceutical ingredients boosted the bioactivity and efficacy.

The non-steroidal drug PTB323X was developed via ITRI's botanical technology platform.

The drug provides a safer and effective non-steroidal drug solution that can reduce psoriasis-like inflammation and desquamation of animal skin. PTB323X can also inhibit skin keratinization. Its efficacy is superior to clinically used vitamin D derivative, without the increase in blood calcium that is the side effect of vitamin D derivative. PTB323X IND (Investigational New Drug) application was approved by TFDA in 2020, and patents have been applied for in Taiwan, the US, China, the EU, and Japan. PTB323X and its technology platform won a gold medal for Outstanding Research at ITRI earlier this year. The core technology platform used in the development of PTB323X contains medicinal ingredient GACP (Good Agricultural and Collection Practice) cultivation, GMP (Good Manufacturing Practice) production, pharmacodynamic research, mechanism of action (MOA) research and toxicological studies, which can boost pharmaceutical applications and services.

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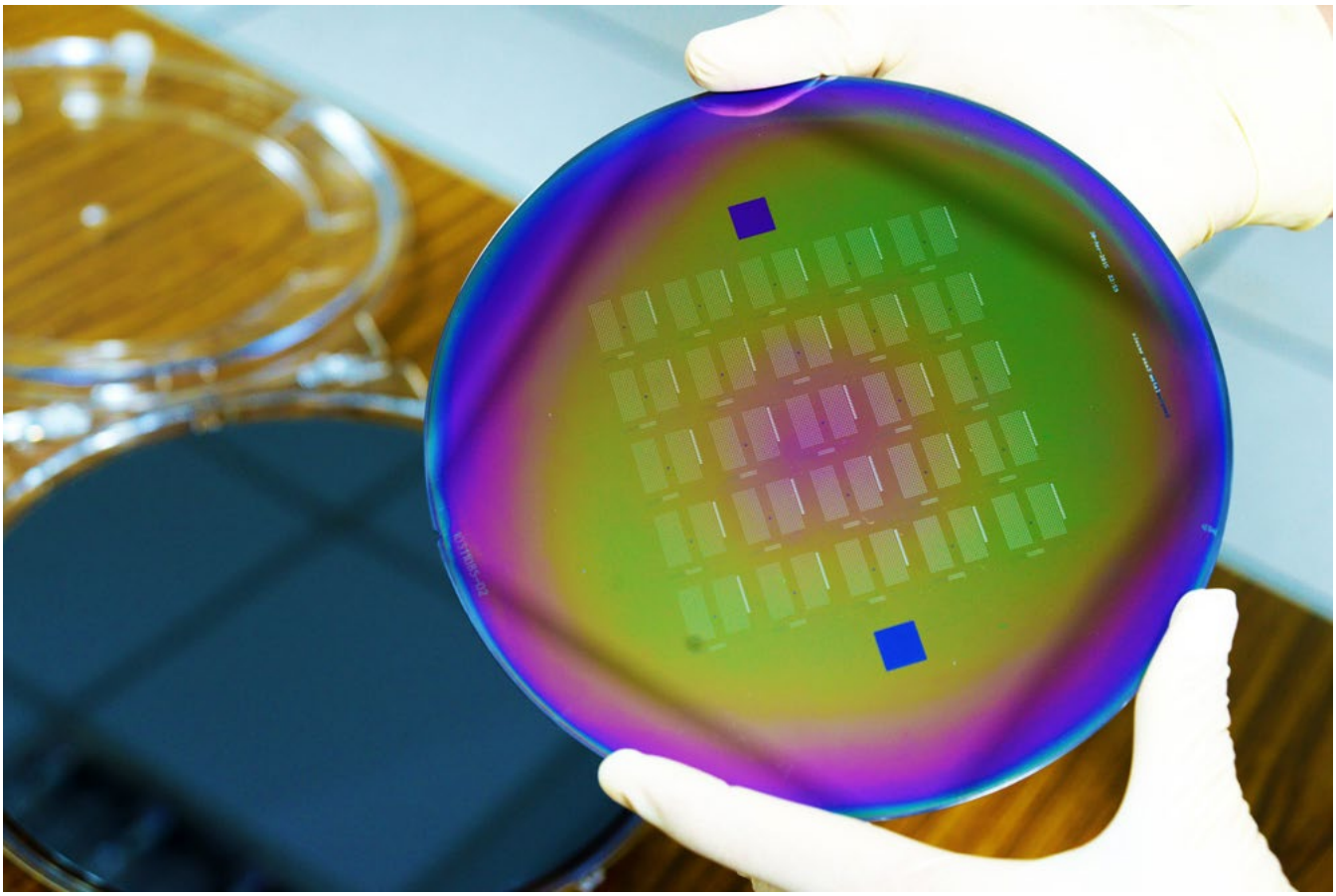
» Feature

Phased Array Variable Frequency Microwave Technology



Phased array variable frequency microwave technology is used to selectively apply heat to certain components or substances within a material.

With the evolution in semiconductor fabrication, component line width and film thicknesses below 10 nm are easily affected by the high temperature annealing process (up to 900°C), causing elemental diffusion or crystallographic defects. This often results in component failures. Alternatively, microwaves allow direct heating of semiconductor film materials at a low temperature, improving on the shortcomings of the conventional method.

Thanks to integrated controls for microwave phases and variable frequencies, ITRI's innovative Phased Array Variable Frequency Microwave Technology is able to maintain the temperature at below 500°C, providing even heating in the process at a low temperature.

Dr. Kun-Ping Huang, Project Manager of ITRI's Mechanical and Mechatronics Systems Research Laboratories explained that ITRI's technology can adjust the microwave output according to the material's absorption frequency, reducing the required annealing process time and material defects. "Compared to other microwave annealing methods, ITRI's technology saves half of the cost and shows greater market competitiveness," he said.

The Phased Array Variable Frequency Microwave Technology has three distinguishing features: (1) High flexibility: It has excellent phase modulation that allows heat to be applied as needed; (2) High uniformity: The uniformity of its microwave field reaches >99%, reducing annealing performance non-uniformity at a low temperature; (3) All-round heating: Selective microwave frequency output deals with the issues commonly found with conventional fixed microwave frequencies.

Currently, ITRI has already begun collaboration with international semiconductor manufacturers, and the technology has been transferred to traditional manufacturing and the recycling industries. Other than its use in the semiconductor industry, this technology has potential for applications in the photovoltaics, chemosynthesis, carbon fiber, and agricultural product drying industries. The Phased Array Variable Frequency Microwave Technology received a gold medal for Outstanding Research at ITRI in 2021.

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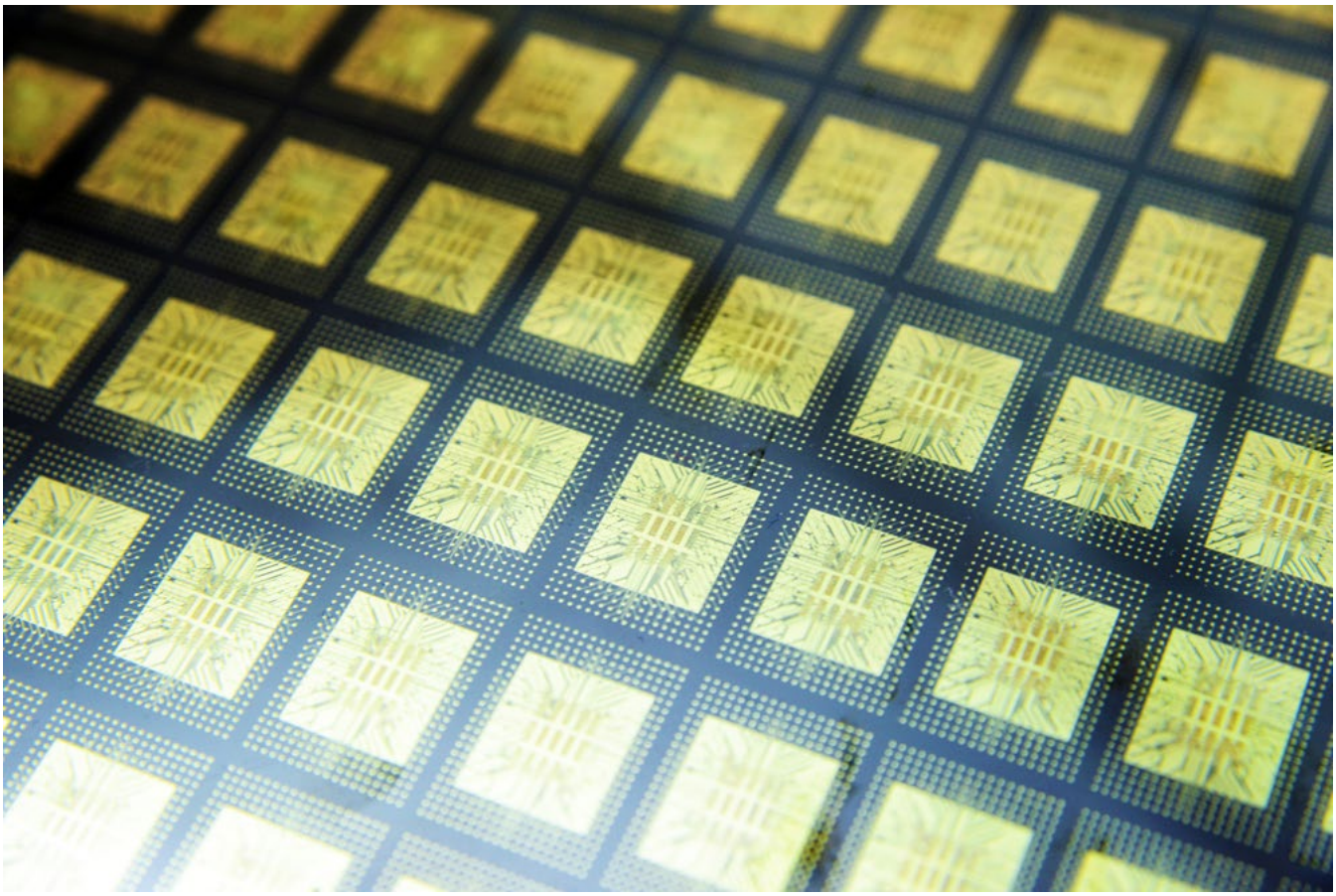
High Aspect Ratio TGV Filling and Inspection Technology

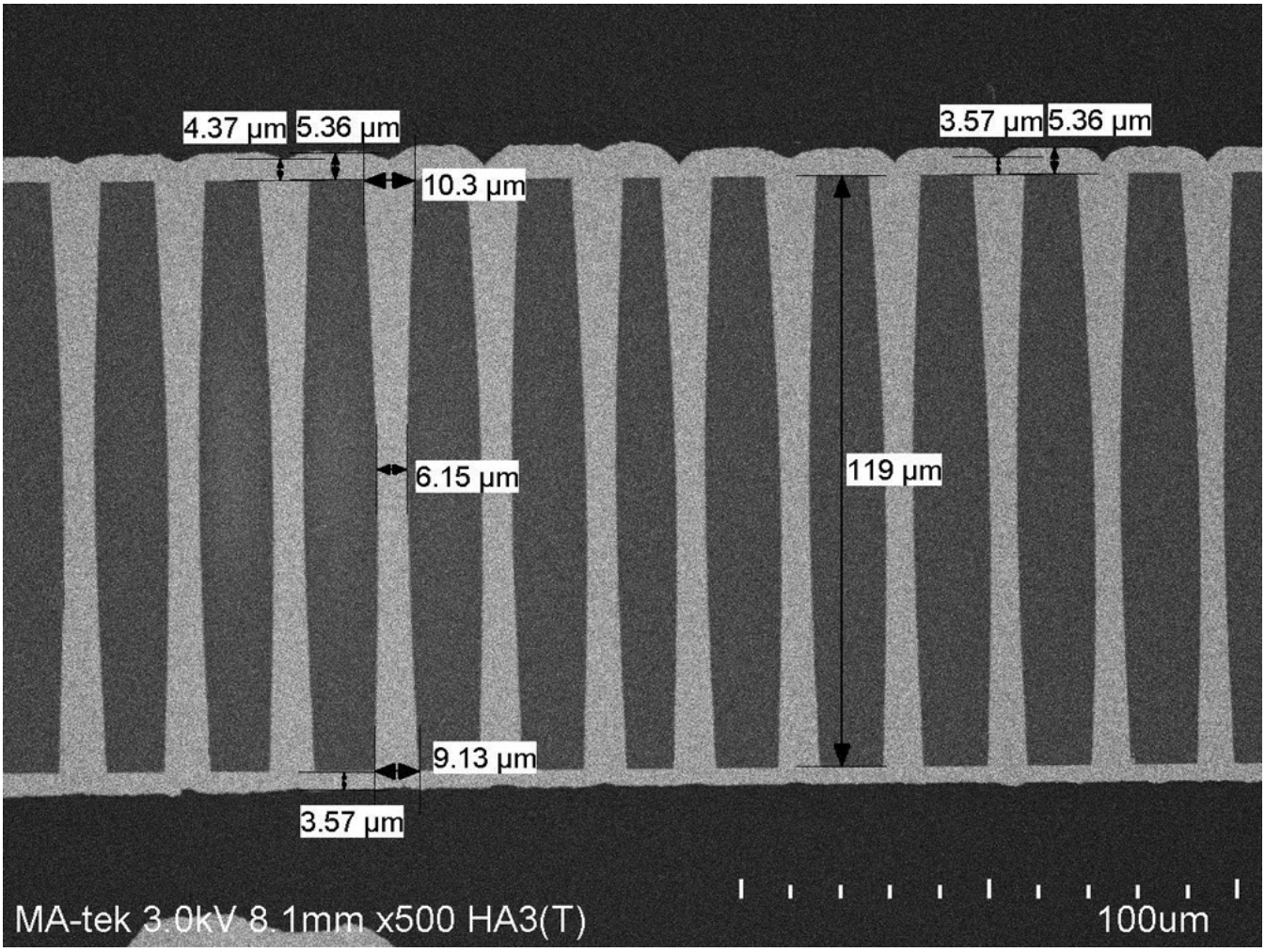


ITRI's High Aspect Ratio TGV Filling and Inspection Technology increases electrode density and optimizes 3D IC stacking.

In 3D semiconductor packaging, high aspect ratio (HAR) through glass via (TGV) substrate has shown promise as an interposer substrate, providing many advantages over silicon wafer, due to its low dielectric constant, high dimensional stability, ultra-high resistivity, low coefficient of thermal expansion (CTE) mismatch between copper (Cu) material & glass substrate, and good mechanical properties. However, both an all-solution process for HAR TGV with defect-free filling, and a more effective defect inspection method, are still needed.

To address these challenges, ITRI has developed the High Aspect Ratio TGV Filling and Inspection Technology. The TGV filling process uses a simple DC plating waveform with a single plating additive formula to replace the complex PPR (Periodic Pulse Reverse) plating

waveform to form the uniformed Cu bridge (butterfly) in the center of TGVs. Moreover, the Cu surface thickness (Cu overburden) can be controlled in the range of 5-10 μm, which is based on the aspect ratio, via size, and substrate thickness. This TGV filling technology employs a full wet process for an aspect ratio (AR) over 15, superior to the commercially available AR between 4-10 that uses both dry and wet processes. ITRI's full wet process needs only one plating additive formula instead of three types of plating additives (accelerator, suppressor and leveler) required by the conventional formula, reducing the need for complex monitoring of individual formulas and resolving the problem of excessive consumption of plating additives for long-term use.



An SEM cross-section image shows that ITRI's technology has a higher aspect ratio than currently available hole plating processes.

Dr. Meng-Chi Huang, Deputy Division Director of ITRI's Mechanical and Mechatronics System Research Laboratories, explained that stacking integration of 3D chips is similar to constructing a building, with floors and levels being interconnected by the superstructure and utility lines. The glass substrates are like the "floor panels", and the through vias in between levels are like the power or water lines that link the entire building. The TGV filling process is therefore an integral part in stacking integration, taking up to 30% of the packaging cost. Dr. Huang stressed that ITRI's technology has the potential to lower plating cost by 50% compared to current practices.

Apart from TGV filling, defect inspection for the TGV filling process is also crucial. ITRI's 3D Nano X-ray CT inspection technology performs faster than conventional 3D X-ray interpretation which often takes one to two weeks. Sphere-fitting algorithm is developed to combine with Nano-CT scanning to quickly identify hundreds of defects within one or two hours and achieve a high accuracy. The monitoring system can catch cracks and voids up to 2μm, greatly improving production yield and quality.

ITRI's High Aspect Ratio TGV Filling and Inspection Technology can be used by those who would like to upgrade advanced semiconductor packaging from silicon wafers to glass substrates, making manufacturers more competitive when entering the global semiconductor packaging, high density PCB and IC substrate supply chains. For its technological breakthroughs and influence on multiple industries, the technology received the Outstanding Research gold medal at ITRI in 2021.

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» Spotlight

AI Thermal Image Body Temperature Detection Technology for COVID-19

ITRI's Thermal Image Body Temperature Detection Technology now integrates color cameras and thermal imaging sensors.

ITRI is committed to developing epidemic prevention technology amid the COVID-19 pandemic. The use of its Thermal Image Body Temperature Detection Technology together with AI and infrared thermal image color displays enables the detection of forehead temperatures for multiple individuals concurrently. Supported by the Ministry of Economic Affairs (MOEA), this R&D result offers a non-contact, high-precision, full-color detection solution that can improve contact tracing and thus contain the spread of COVID-19.

Since April 2020 when the Thermal Image Body Temperature Detection Technology was first unveiled, ITRI has been helping various sectors install hundreds of systems for temperature screening upon entrance to the facilities, including at the MOEA, the Examination Yuan, the

Kaohsiung City Government, Taiwan Semiconductor Manufacturing Company (TSMC), National Yang Ming Chiao Tung University, and many other locations. This year, entry and exit controls have been added into the design of these systems, paving the way for even more comprehensive monitoring mechanisms.

Unlike most thermal imaging cameras, ITRI's technology can provide and store full color images.

According to the survey by the Business Research Company, the demand for infrared thermometers has soared due to the COVID-19 pandemic—the market for these devices has reached US$17.82 million, a rise of over 55% compared to 2019. Dr. Chun-Hsun Chu, General Director of ITRI's Smart Microsystems Technology Center, emphasized that unlike most thermal imaging cameras that offer only a single-color image, ITRI's new generation technology is innovative in integrating color cameras and thermal imaging sensors to store color images of people with elevated body temperatures. This aids in follow-up contact tracing, he added.

The new feature of color imagery greatly improves entry and exit controls, addressing the needs of government agencies and private companies that have large numbers of people passing through their doors. In practice, ITRI has helped TSMC integrate the body temperature detection system with the company's employee ID data for the access control at its Hsinchu facility. This also meets the requirements of the real-name system by the Central Epidemic Command Center, while reducing monitoring time and manpower needs by over two-thirds compared to manual temperature measurement.

ITRI's Thermal Image Body Temperature Detection Technology combines AI to enable automated detection of forehead temperatures, avoiding errors caused by interference from other heat sources. Temperature compensation technology is utilized in conjunction with the Internet of Things (IoT) to sense the distance between detection device and heat source, along with ambient temperature and humidity levels. The system then compensates and calibrates the data detected, and dynamically uploads daily temperature information of the individual, along with ambient data to a database. Indoor and outdoor measurement errors can be maintained within a range of +/- 0.3 degrees Celsius, offering an accuracy of up to 90%.

The improved Thermal Image Body Temperature Detection Technology features non-contact high-precision detection capabilities.

Some companies have pointed out that they introduced temperature detection devices using ITRI's Thermal Image Body Temperature Detection Technology since the beginning of the year, with the equipment exhibiting a high degree of stability. This has effectively alleviated the need for handheld temperature measurement equipment, while improving accuracy and speed. This also means a reduction in unnecessary contact among frontline workers, thereby increasing safety in the workplace.

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» Spotlight

ITRI and Chi Mei Medical Center Transform Shipping Containers into Testing Lab

To meet the ongoing demand for COVID-19 testing in Taiwan, ITRI and Chi Mei Medical Center have joined hands in the establishment of a second high-throughput nucleic acid diagnosis facility for COVID-19 testing with the support from the Ministry of Economic Affairs (MOEA). The Prefabricated Negative Pressure Ultra-High Throughput COVID-19 Testing Container Lab was deployed this June at Chi Mei Medical Center's Yongkang branch in Tainan. The testing lab features three interconnected containers, two separate routes to maintain safe working flow, and a one-stop platform for COVID-19 testing. It provides services covering the whole process from sample collection to nucleic acid testing in a safe and qualified environment.

ITRI and Chi Mei Medical Center collaborated on the prefabricated container lab.

According to ITRI President Dr. Edwin Liu, the MOEA put its full support behind the research

and development of projects for pandemic prevention technologies, including ITRI's development of positive pressure testing booths and other technologies in response to COVID-19. As Chi Mei Medical Center is one of the most important medical facilities in southern Taiwan and offers the largest hospital capacity in the Yunlin-Chiayi-Tainan region, Dr. Liu hopes that the equipment developed by ITRI will provide a one-stop service for sample collection and testing processes, while enhancing protection for medical staff.

Chi Mei Medical Center Superintendent Dr. Chung-Ching Chio commented that since the local outbreak in May, Chi Mei has performed over 23,000 nucleic acid tests. In response to possible cluster infections, Chi Mei has introduced a second set of high-throughput nucleic acid testing equipment and worked with ITRI on the creation of the Prefabricated Negative Pressure Ultra-High Throughput COVID-19 Testing Container Lab. The interior space fulfills the biosafety level 2 (BSL-2) laboratory specifications, and increases the number of daily rapid tests by about 1,000 people.

The container lab can increase the number of nucleic acid tests by about 1,000 people daily.

The ITRI team applied its experience of creating negative pressure wards during the SARS epidemic in the container design, with five primary features:

1. BIBO HEPA Filtering: A Bag-in/Bag-out (BIBO) HEPA filter system is used to purify the exhaust and provide clean air.

2. Class 10000 of air cleanliness: The testing lab is as clean as an operating room.

3. Negative Pressure Value ≧8 Pa: The BSL-2 negative pressure laboratory prevents the spread of pathogens.
4. Mobile Deployment: The container module can be quickly disassembled and assembled, making it suitable to be deployed on a temporary basis.
5. Independent Energy System: A generator-based power supply system, water purification system and wastewater reclamation system are included.

The mobile COVID-19 testing lab is built by the combination of three 20-foot containers. The interior includes a sample process area, a PCR operating area, a facility room, a buffer zone, and a clothes changing room. The medical staff enter the positive pressure buffer zone after changing clothing. They then go to the sample process and PCR operating areas. The one-stop testing service proceeds as follows. The testees have their samples taken in the positive pressure testing booth set up outside. After that, the specimens in transfer boxes are sent to the sample process area for examination avoiding cross-contamination and then to the PCR operation area for testing in the high throughput automated equipment. Medical staff are isolated at each step to reduce the risk of infection.

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» R&D Focus

How New Technology Assists in PCB Industry

ITRI has been developing smart tech solutions to resolve challenges facing the PCB industry.

Taiwan has been known as the world's leader for the PCB industry, holding the largest market share for 10 consecutive years. Despite this remarkable feat, there are still some challenges facing its PCB manufacturers, such as understaffing, human errors, and production capacity. To address these problems, ITRI has developed a smart manufacturing service application platform and IT solutions to optimize the PCB manufacturing process.

Click below to learn about how ITRI utilizes technology innovation to assist in industrial transformation.

Smart Manufacturing Service Application Platform for Circuit Board Industry
IT Solutions to Increase Productivity for PCB Laminate Manufacturers

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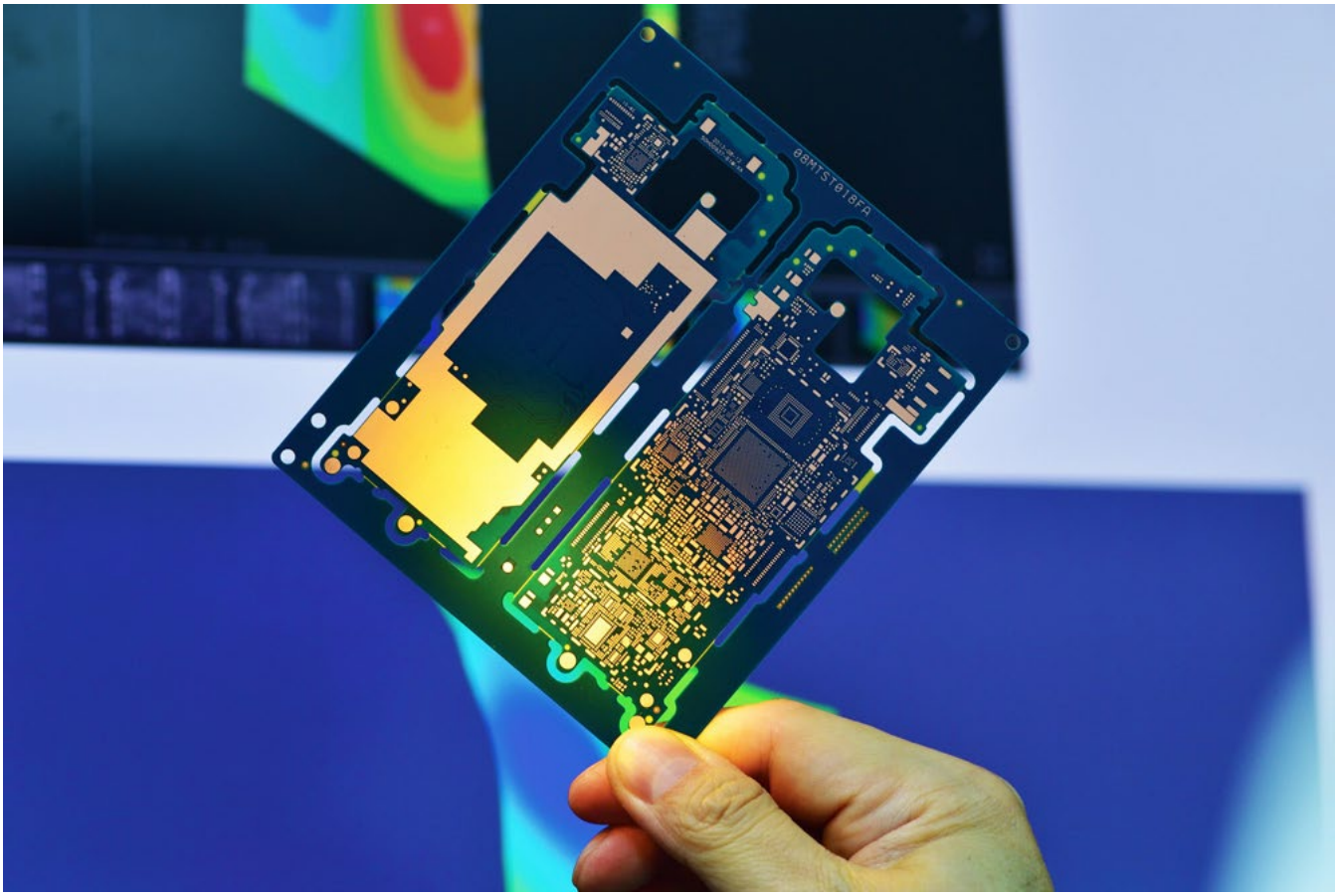
» R&D Focus

Smart Manufacturing Service Application Platform for Circuit Board Industry

Taiwan has been known as the world's leader for the PCB industry, holding the largest market share for 10 consecutive years. Despite this remarkable feat, there are still some challenges facing its PCB manufacturers, such as skilled labor shortage and defects caused by human errors. To overcome these issues, ITRI has developed the Smart Manufacturing Service Application Platform for Circuit Board Industry, which was recognized with the Industry Contribution Award gold medal this year.



ITRI developed a smart manufacturing service application platform to upgrade Taiwan's PCB industry.

The platform features three key technologies as follows:

Printed Circuit Board Equipment Communication Interfaces (PCBECI)

PCBECI is the world's very first communication protocol developed specifically for the PCB industry. By implementing PCBECI across the industry, different manufacturers will be able to follow the same protocol when processing and integrating equipment data, thereby reducing the time and costs involved in the production process.

Integrated Root Cause Analysis Model Technology

Using multiple analysis models, the technology identifies and prioritizes the key factors which lead to flawed products. The production equipment can then take the factors as a reference to automatically correct and calibrate the defects in the products, reducing the reliance on senior workers.

AI Reimaging and Defect Categorization Technology

By utilizing image fusion techniques, the technology compares the AI-reconstructed image with the original, which helps detect flaws that could be easily overlooked by humans and thus improves the quality of the products.

Dr. Ta-Hsin Chou, Deputy General Director of ITRI's Mechanical and Mechatronics Systems Research Laboratories, emphasized that ITRI's Smart Manufacturing Service Application Platform for Circuit Board Industry provides an integrated solution to the PCB industry. Rather than targeting only one specific problem, the platform fulfills multiple needs of the PCB industry to achieve optimal performance, he added.

A major flexible PCB manufacturer in Taiwan incorporated this platform and worked with upstream companies such as material suppliers and system integration companies to upgrade its production process. This forms Taiwan's first PCB production line that spans different parts of the supply chain and significantly improves the yield rate.

The platform also helped another printing equipment supplier successfully transform from a traditional manufacturer into a system integrator. Dr. Yu-Ming Wang, Division Director of ITRI's Mechanical and Mechatronics Systems Research Laboratories, noted that the transformation allowed the company to win orders from a major PCB manufacturer in Thailand.

Regarding the future development of the platform, Dr. Chou expects that in addition to giant PCB corporations, small- and medium-sized enterprises can employ the platform to optimize their production process. The platform is expected to accelerate the industrial upgrade and transformation for Taiwan's PCB industry to secure its leading position in the global market.

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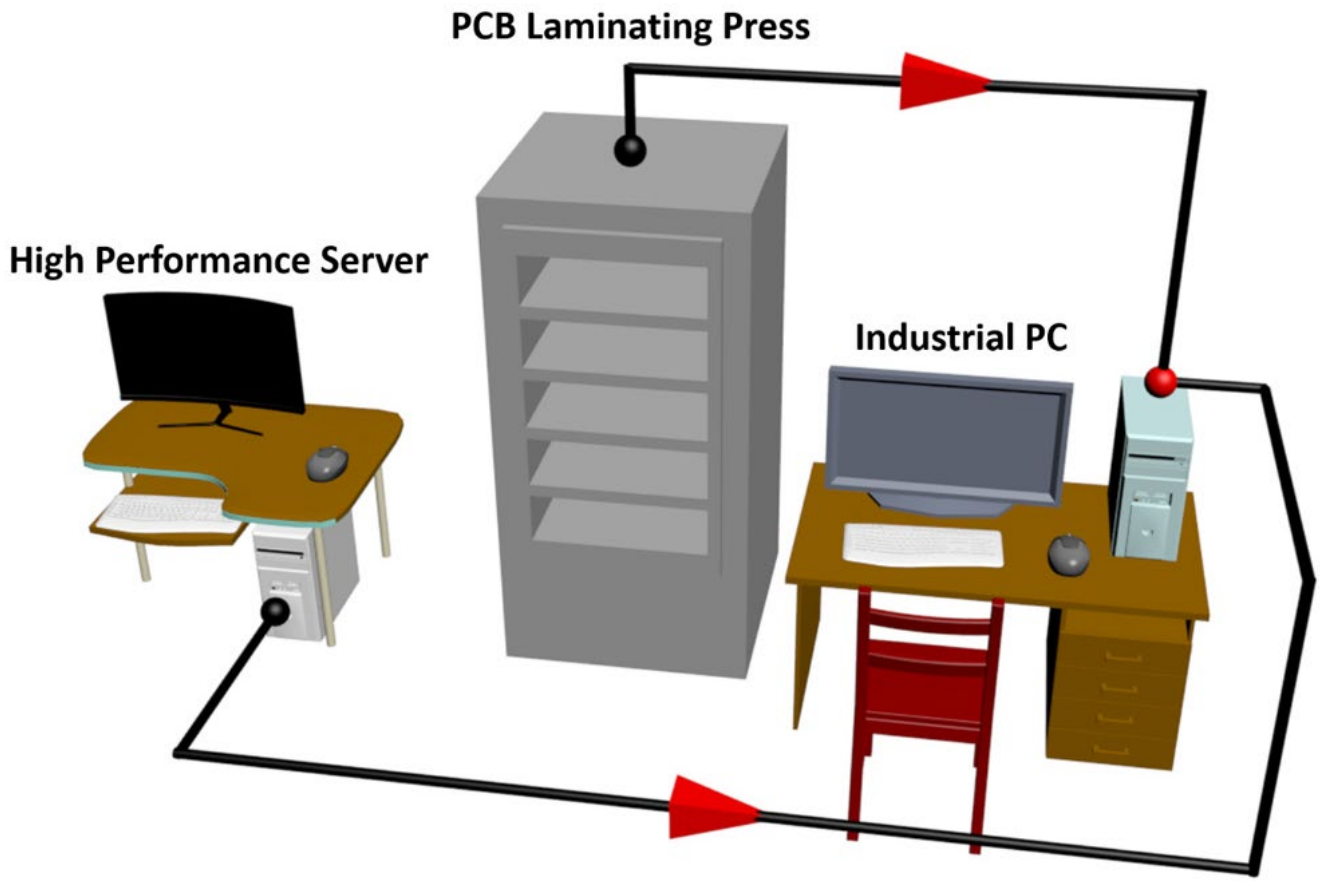
» R&D Focus

IT Solutions to Increase Productivity for PCB Laminate Manufacturers

By Wei-Lun Liang



An Industrial PC is used to control a PCB laminating press and remotely access a high-performance server that can perform a variety of tasks on data.

Taiwan's printed circuit board (PCB) industry is one of the largest in the world. However, how to improve yields has been a critical issue facing PCB laminate manufacturers. This article demonstrates an example of how ITRI offers IT solutions to increase the efficiency and productivity of the PCB manufacturing process.

Lamination describes a process of building up successive layers of a material and binding these layers to strengthen, protect and waterproof a variety of substances. The routine of a conventional PCB laminate manufacturer would be like this: Managers formulate production schedule planning in accordance with the customers' orders and production capacity. Then

they analyze very large data sets of materials to generate results for different property values over a period of time. However, algorithm calculation relies heavily on human intelligence; without the use of computer tools, it takes time and labor. ITRI researchers were aware of this concern and decided to write programs with efficient algorithms that can perform mathematical calculations much faster to streamline the process. The calculator programming can help workers to place layers of materials into openings in PCB laminating presses and calculate materials consumption, saving significant time and effort. Moreover, in order to ensure the reliability and stability of the original PCB system, we propose a method for keeping the original stabilization system by using a high-performance server to perform a variety of tasks on data as illustrated in the image above.

The unintentional manufacturing failures and other undesirable issues caused by operators' behavior are another challenge, which will break the empirical rules during the PCB lamination process. To offer best-practice advice for reducing the likelihood of human errors and product failure, ITRI created a system that is capable of identifying and correcting anomalies automatically; furthermore, ITRI provides machine condition monitoring by using artificial intelligence (AI) technology as a service. Seven-segment panels of an instrument of the PCB show decimal numerals to reflect the working status of the equipment. ITRI designed an AI system for recorded information according to the digits of its occurrence, and the digital readout provides a discrete output indication. This constitutes an alarm system which can detect an event when the digits fall outside the range of accuracy. When a human error or a machine breakdown causes the task to exceed acceptable limits, the alarm system will be triggered and sound an alert. Managers can then take appropriate action to fix the manufacturing failure promptly.

PCB laminate manufacturers who leverage technology to improve productivity are expected to gain a massive advantage over their competitors. This is why ITRI has been working relentlessly to assist the PCB industry in introducing AI technology into the manufacturing process to boost workflow efficiency and industrial competitiveness.

Acknowledgement:

I would like to express my profound gratitude to technical manager Chang-Tzu Lin, consultant Li-Shen Chen, and technical supervisor Yung-Fa Chou. They gave me a golden opportunity to do this wonderful project to improve the PCB lamination process. Thanks to their inspiring suggestions and valuable experience, the project has made constant improvement and I am so proud to be part of the team.

About the Author

Wei-Lun Liang is an engineer of the Chip

Stacking Technology Department of the Information and Communications Research Laboratories at ITRI. Liang graduated from National Taiwan University. He specializes in optical system design and artificial intelligence and currently works as a senior computer programmer.

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Showcasing 5G O-RAN Based RIC with Pegatron and Keysight at MWC

ITRI, Pegatron, and Keysight showcased innovative 5G technologies at MWC 2021.

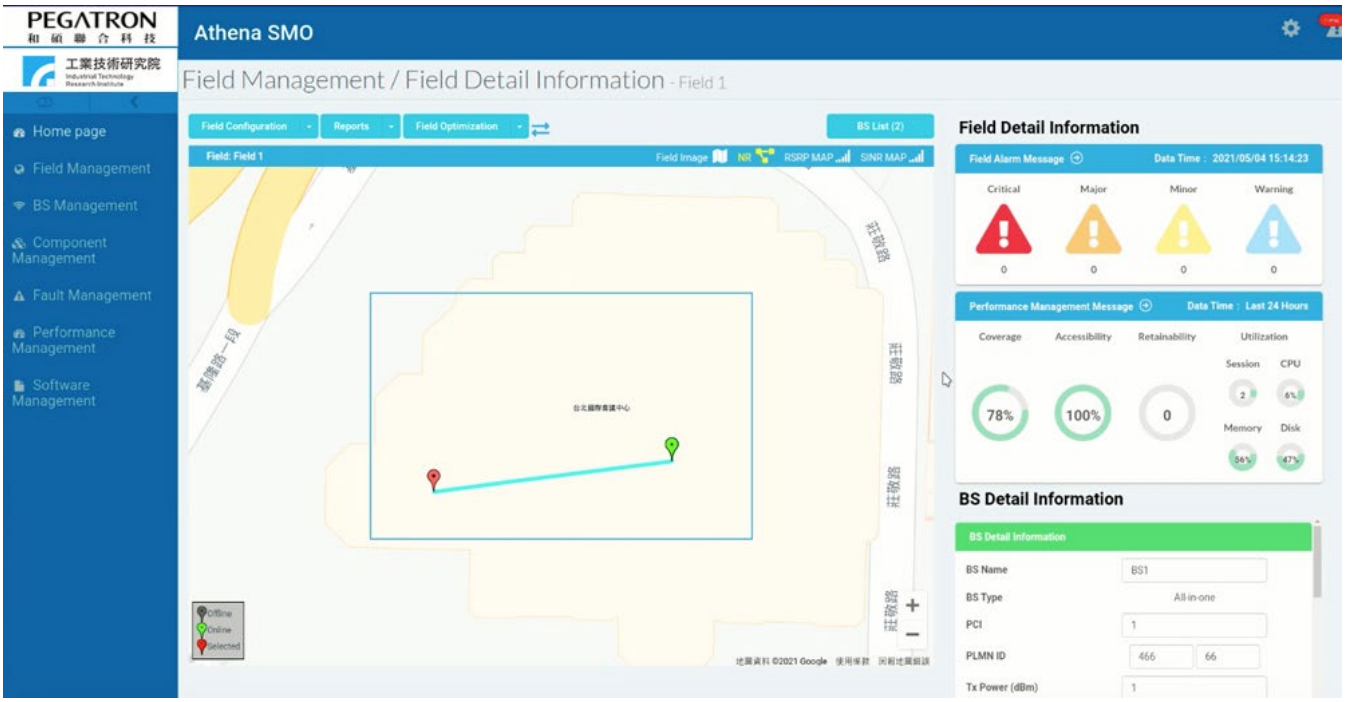
Open Radio Access Network (O-RAN) has become the popular architecture that the world is adopting for 5G deployment. According to a Research Nester O-RAN report, the total market value of O-RAN will reach US$21 billion by 2028 and the compound annual growth rate (CAGR) will be 83.1% from 2020 to 2028. In response to this emerging market, ITRI has collaborated with Pegatron Corporation and Keysight to develop Taiwan's first RAN Intelligent Controller (RIC) that complies with the 5G O-RAN architecture. It further joined hands with these two electronics companies to showcase this R&D result at the Mobile World Congress (MWC) in a digital format in June, 2021.

In the collaboration on developing 5G O-RAN RIC and its applications, Pegatron has built its 5G base station based on the O-RAN architecture. When equipped with ITRI's 5G O-RAN RIC,

the base station can optimize performance for different applications. It lowers the hardware costs while providing highly available and customized services. Keysight, on the other hand, has developed 5G test solutions that assist in validating the performance of network equipment and infrastructure. These solutions help enhance efficiency and provide low latency communications to enable quality network services. Utilizing Pegatron and Keysight's technologies, ITRI has demonstrated new advancements in 5G O-RAN end-to-end private network system at MWC, one of the most influential annual exhibitions in communications technology.

Dr. Tzi-Cker Chiueh, Vice President and General Director of ITRI's Information and Communications Research Laboratories, indicated that 5G O-RAN RIC is a pioneering system that can accelerate the deployment of base stations, improve operation and management efficiency, and thereby lower labor costs. This resolves the current major challenge for the 5G market—the substantial manpower and expenses required for the establishment, operation, and maintenance of base stations.

5G O-RAN RIC includes three key features: 1) Element Management System, which provides simple and integrated management of base stations and cloud platforms; 2) Non-RT RIC, which provides the ability to flexibly configure the desired optimization policies; and 3) Near-RT RIC, which operates in near-real-time for RAN control and optimization.



The web interface of 5G O-RAN RIC.

The rapid 5G expansion will be an opportunity for Taiwan to increase its competitiveness in the digital era. It is believed that ITRI and its key industry partners' breakthroughs in 5G innovation can boost technological upgrade and industrial transformation, accelerating entry to the global communications market.

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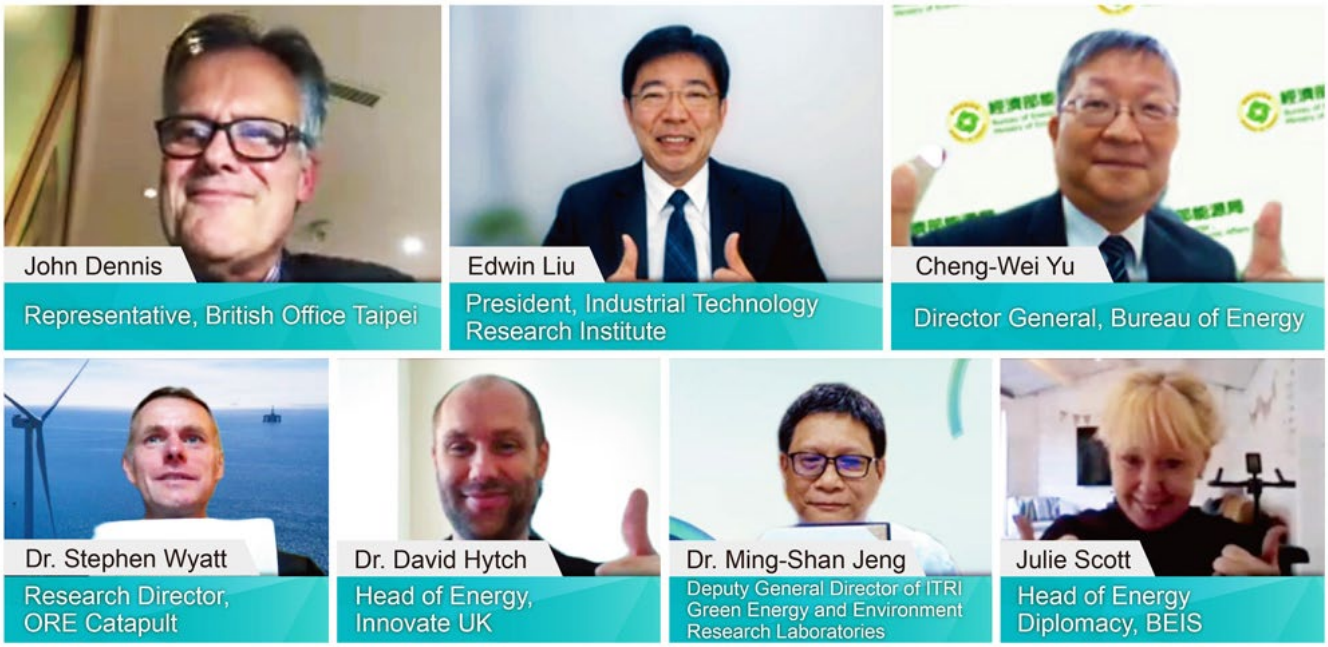
» Collaboration

ITRI and the UK's ORE Catapult Sign MoU to Enhance Taiwan's Offshore Wind Generation Ecosystem

With support from the Bureau of Energy under the Ministry of Economic Affairs (MOEA) and the British Office in Taipei, ITRI and the UK's Offshore Renewable Energy Catapult (ORE Catapult) on July 6 signed a Memorandum of Understanding for cooperation on offshore wind generation. This paves the way for an innovation program focusing on offshore wind operation and maintenance technology that is based on the related experience of the UK, which has the highest installed offshore wind power capacity in the world. Technical exchanges will strengthen R&D capacities, while contributing to the improvement of Taiwan's offshore wind generation ecosystem.

According to the energy industry research organization Wood Mackenzie, the global offshore wind generation operation and maintenance market will reach US$13.9 billion in 2028, with Taiwan's market valued at US$1.07 billion. In addition to the joint creation of an Innovation Programme, the memorandum will enable the establishment of a joint working group to focus on wind turbines, submarine cable equipment, and power facilities. It will also introduce innovative AI and big data technologies to promote offshore wind generation operation and maintenance to become more automated, digitalized, and smart, consequently reducing energy costs. It is hoped that the introduction of related technology will help establish the vibrant development of this industry.



ITRI and the UK's ORE Catapult signed a Memorandum of Understanding on Offshore Wind Generation, Technology Cooperation, and Information Exchange.

“UK-Taiwan cooperation in offshore wind is growing fast with 30 UK businesses now set up in Taiwan to support the sector,” said John Dennis, Representative of the British Office in Taipei. “It’s fantastic to see our partnership develop further with this MOU, which will include UK-Taiwan R&D collaboration and spur new innovations in the sector, increasing renewable capacity in Taiwan and helping to reduce carbon emissions.”

Cheng-Wei Yu, Director General of the Bureau of Energy, remarked that promoting offshore wind power is an important direction of development for Taiwan. “The government is committed to such policies to encourage related academic research and technology R&D, with the hope of achieving the energy transition to renewables and becoming a hub for offshore wind generation in Asia,” he said. The UK has accumulated considerable experience in offshore wind generation and has successfully developed an offshore wind generation industry, he pointed out, adding that he is pleased to see ITRI and the UK’s ORE Catapult engage in cooperation, and looks forward to this cooperation yielding abundant results.

ITRI President Edwin Liu commented that economic development around the world is leading to an increase in global demand for energy. Taiwan is actively developing renewable energy sources, hoping to increase its energy independence. He visited ORE Catapult in 2019, and since then the two sides have engaged in cooperation. Taiwan’s wind farms will gradually see completion, and Dr. Liu hopes to incorporate more recommendations and experiences from those with an international perspective. In particular, ORE Catapult has extensive experience and state-of-the-art research in the development of offshore wind generation. The Taiwan Strait has potential to become one of the best wind farms in the world, and he sees cooperation with ORE Catapult as extremely promising. “This will foster more comprehensive development of the wind generation industry locally and will create a win-win opportunity for the industries of both Taiwan and the UK,” he said.

“Taiwan’s first offshore wind farm began commercial operation in 2019, and several wind farms will continue to be completed in the future. After the wind farm is completed and connected to the grid, it will enter the operation and maintenance (O&M) period of at least 15 years, therefore O&M technology is a key research area for ITRI,” said Dr. Ming-Shan Jeng, Deputy General Director of ITRI Green Energy and Environment Research Laboratories. “We have been engaged in international cooperation for the past two years. With the UK’s profound experience in offshore wind development, we are glad to cooperate with ORE Catapult and hope to accelerate research and development through offshore wind technology exchange and information integration.”

Dr. Stephen Wyatt, ORE Catapult Research and Disruptive Innovation Director observed, “Taiwan is one of the most innovative, progressive and fastest-growing markets for offshore wind technologies in the world. And as the largest offshore wind market in the world, the UK has a wealth of technologies, experience and know-how that can be shared with one of our largest global trading partners, helping us to expand global clean energy generation, reduce carbon emissions and tackle climate change.”

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» Activity

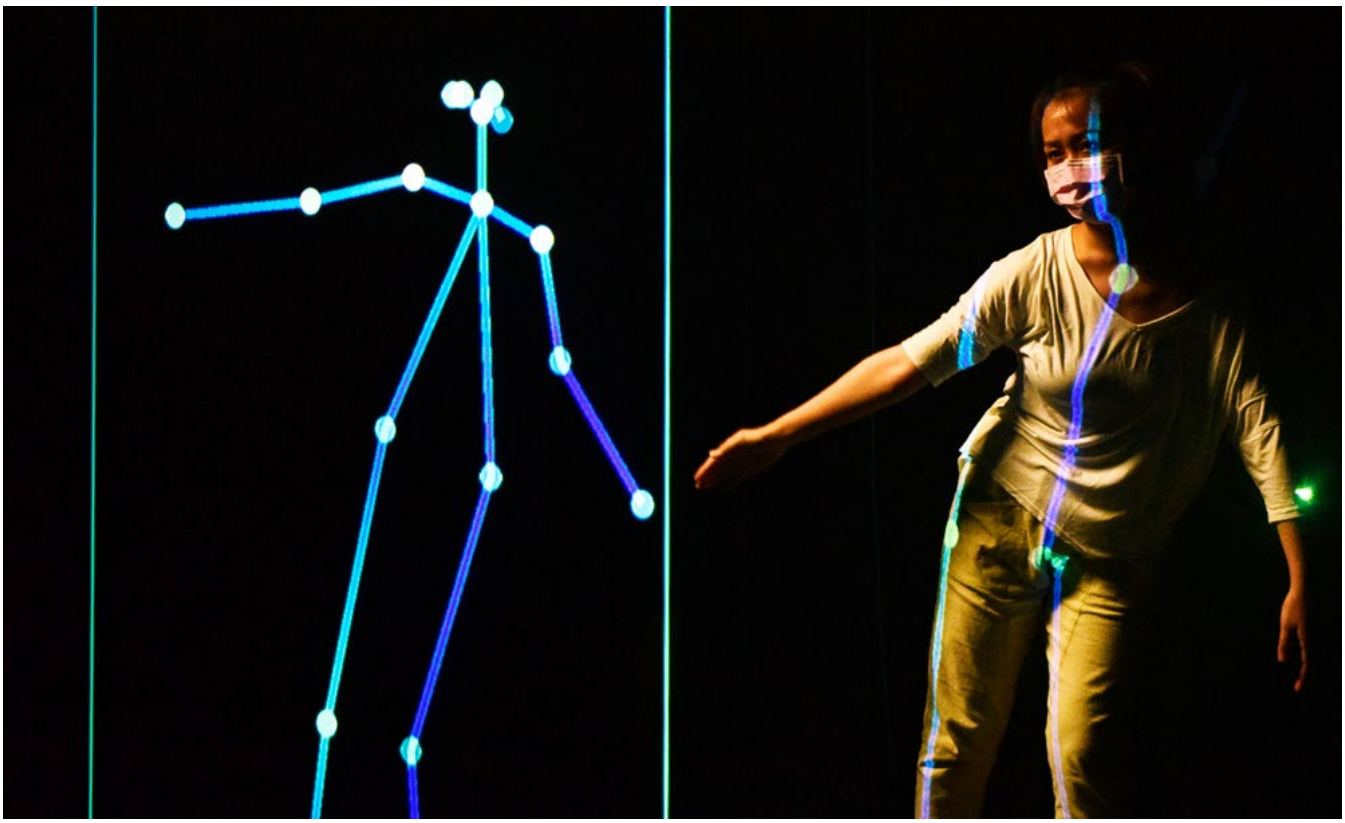
Arts@ITRI Residency Project 2020-2021

Video of Arts@ITRI Residency Project 2020-2021.

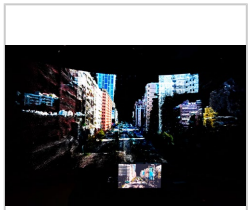
The 2020-2021 Arts@ITRI residency project opened the doors to co-creation between ITRI's laboratories and artists interested in exploring the union of art with technology. This year marks the second edition of the program. Projects being exhibited include Wei-Hsuan Huang's *"Modernological Urbanscape,"* Jeff Hsieh's *"Cyborg Eros,"* Chien-wei Liu's *"Jinshan No.14,"* and Jiun-ting Lai's *"HAOS Human and inhuman. The in-between."* These projects were produced in conjunction with several of ITRI's laboratories, testing how the technologies of 3D printing, AI image recognition, circuit design, ultra-fine LED display, transparent screens, and new media and sensing factored into dance theater, super-human perception, VR scenes, and the restoration of cultural artifacts.

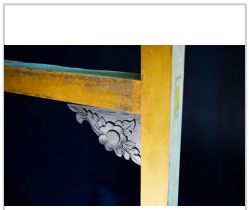
This inter-ministerial, inter-disciplinary cooperation project has been carried out by ITRI with the support of the Ministry of Culture and the Smart Transparent Display VR Integration System Development Project under the Ministry of Economic Affairs' Department of Industrial Technology. It is hoped that combining state-of-the-art technology and art will not only hone the technological capabilities of artists, but also challenge the limits and imagination of

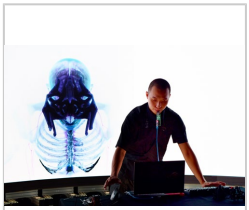
researchers in the application of technology.



Jeff Hsieh's "Cyborg Eros" features a performer from Anarchy Dance Theatre dancing with an AI before a transparent display.







In Wei-Hsuan Huang's project, the artist uses 3D scanning and digital imagery design to shoot images in the first person, calculated and reconstructed spaces, and employs imagery measurement methods to reconstruct what was experienced, thereby exploring how 3D data can be re-presented and re-experienced. ITRI developed sports physiological perception hardware & software systems, AVMR, and integrated audio-visual applications. These technologies assisted Huang in introducing digital avatar-related technology applications to form an innovative model for experiencing virtual space. By interacting and touching objects via the avatar while receiving feedback to the senses, Huang hoped to blur the boundaries between the virtual and the real world, probing the idea of consciousness.

Jeff Hsieh's work employs different analytical systems to analyze a dancer's posture, and it explores how AI recognizes the human body, its principles, applications and crises in the future era of cyborgs. Hsieh's work forms a complete "smart image analysis engine." He experimented with multi-body combination modeling to simulate a futuristic new body

experience. The dislocation and grafting of various limbs of the dancers, along with the integration of technology images, adds to the physical texture of a cyborg.

Chien-wei Liu's *Jinshan No.14* project explores how scanning and 3D printing can be applied to the restoration of historical relics, and addresses the ambiguity between restoration and creation. Liu's work is a cross-domain cultural conservation and technology creation. Working with ITRI's researchers, he used 3D scanning & printing and experimental materials to transform the appearance of the object, attempting to construct a virtual and real space, while discussing the value of art and cultural content.

New media artist Jiun-ting Lai collaborated with several ITRI laboratories in the creation of the tongue-sense electrostatic machine circuit board design 1.0, human augmented organ carrier, and tongue-sense electrostatic machine circuit board design version 1.5. Through these experimental projects, the artist attempted to expand human consciousness. By creating the tongue-sense electrostatic machine as a wearable organ, Lai hopes to escape from the control of capitalism, especially the image made by social media and algorithms.

The four teams also discovered the differences between artistic and technological experiments during the course of cooperation. In the pursuit of precision, for example, artists sought precise expression, while technology developers focused on the pursuit of data. This honed understanding, experimentation, inclusivity, and creativity by individuals from both sides, while touching on their respective areas of expertise. Both artists and researchers had the opportunity to experience the convergence of technology and art, driving new outcomes and possibilities.

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Industrial Technology Research Institute (ITRI) is one of the world's leading technology R&D institutions aiming to innovate a better future for society. Founded in 1973, ITRI has played a vital role in transforming Taiwan's industries from labor-intensive into innovation-driven. To address market needs and global trends, it has launched its 2030 Technology Strategy & Roadmap and focuses on innovation development in Smart Living, Quality Health, and Sustainable Environment. It also strives to strengthen Intelligentization Enabling Technology to support diversified applications.

Over the years, ITRI has been dedicated to incubating startups and spinoffs, including well-known names such as UMC and TSMC. In addition to its headquarters in Taiwan, ITRI has branch offices in the U.S., Europe, and Japan in an effort to extend its R&D scope and promote international cooperation across the globe. For more information, please visit https://www.itri.org/eng.

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- ITRI and the UK's ORE Catapult Sign MoU to Enhance Taiwan's Offshore Wind Generation Ecosystem

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- Arts@ITRI Residency Project 2020-2021

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