NEWSLETTER

September 2020 | No. 4

Vol. 14

清華

National | Tsing Hua | University

NATIONAL TSING HUA UNIVERSITY

CONTENTS

A RAY OF HOPE FOR IMPROVING DEMENTIA TREATMENT

One of the causes of neurodegenerative diseases such as Parkinson's and Alzheimer's is the calcification of the basal nucleus of the brain, which blocks the membrane protein channels on the surface of brain cells, preventing the transmission of signal molecules and nutrients to the cells. A research team led by Prof. Sun Yuh-ju of the Institute of Bioinformatics and Structural Biology, working in conjunction with David Hsiao's laboratory at Academia Sinica's Institute of Molecular Biology, has recently solved the mystery which has long surrounded the molecular structure of the "phosphate transport membrane protein," and their findings are expected to have a significant impact on research into the treatment of dementia.

The team's research was supported by a grant from the Ministry of Science and Technology's Frontier Science Research Program, and has been published in the August issue of *Science Advances*.

According to Sun, the proteins embedded in cell membranes are responsible for transmitting signals and supplying energy to cells, and therefore play a very important role in the development of pharmaceuticals. Phosphate transport membrane protein is an important channel for transporting phosphate and sodium ions into brain cells. But pathological changes can block this channel, allowing calcium phosphate to precipitate on the surface of the cell membrane, which will eventually lead to calcification of the basal nucleus, thereby producing the neurodegenerative symptoms typical of Parkinson's disease and Alzheimer's disease.

Using the light source at the National Synchrotron Radiation Research Center (NSRRC) to conduct X-ray diffraction on phosphate transport membrane protein crystals, Sun's research team obtained a diffraction diagram, which they used to resolve the three-dimensional structure of the membrane protein, allowing them to use the gene sequence to determine the exact location of the mutation in the membrane protein, revealing for the first time the face of dementia on the neurological level.

Sun (left) with research partner David Hsiao of Academia Sinica's Institute of Molecular Biology.

ⓐ Prof. Sun Yuh-ju of the Institute of Bioinformatics and Structural Biology showing team member Tsai Chiayin how to grow a crystal.
ⓑ Team member Tsai Chiayin was in charge of growing the membrane protein crystals.

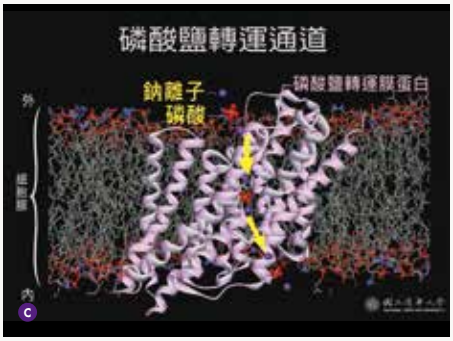
Sun said that analyzing the phosphate transport membrane protein and locating the site of the mutation are the first and second steps in finding a treatment for brain calcification. The next step is to cooperate with physicians in designing drugs based on this structure, using computer calculations and simulations in conducting experiments to identify small chemical molecules effective in restoring the normal functioning of membrane proteins, thereby "reopening the blocked transmission channels, and removing the fog in the brains of dementia patients," as Sun puts it.

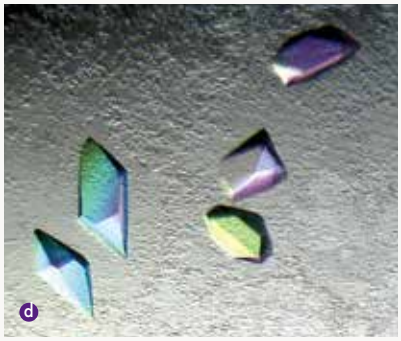
David Hsiao, who specializes in biophysics, played a key role in this innovative research. After Sun's research team analyzed the three-dimensional structure of the phosphate transport membrane protein, Hsiao used an artificial cell membrane to determine whether a mutation at the target location would prevent the membrane protein from transporting phosphate.

There are between 30,000 and 40,000 kinds of proteins in the human body, amongst which membrane protein is one of the most important, and one of the least understood, which is why Sun has made it the focus of her research. Eight years ago she led the first research team in Taiwan to analyze the molecular structure of membrane protein, and it took another 5 years to analyze the molecular structure of the phosphate transport membrane protein.

The first step in analyzing the molecular structure of membrane protein is to cultivate the membrane protein crystal, the structure of which can be seen by using X-ray diffraction. Projecting a microscope image of a membrane protein crystal that is only one-tenth the size of a sesame grain, Sun said that its angular, glittering, and translucent form contains important information on molecular structure, such that it's "more precious and beautiful than a diamond."

The team member in charge of growing the membrane protein crystals was Tsai Chiayin, a postdoctoral researcher at NTHU's Institute of Bioinformatics and Structural Biology. She said that it took a year to cultivate the first phosphate transport membrane protein crystal, and then it took another year to cultivate an optimized and stable crystal, adding with a smile, "growing crystals is a lot like raising children; it requires lots of patience and attention."





ⓒ Phosphate transport membrane protein is an important channel for transporting phosphate and sodium ions into brain cells.
ⓓ It took the team years to finally grow an optimized and stable crystal.

NTHU

TURNING DROSS INTO GOLD

A research team led by Prof. Wu Jyh-ming of the Department of Materials Science and Engineering has recently developed two composite piezoelectric materials extracted from common waste products. One is a new type of catalyst extracted from discarded rice husks, and is capable of treating industrial wastewater 90 times faster than the photocatalysts now in use. The other is a material extracted from discarded squid bones, and has been used to produce a self-sanitizing transparent film suitable for use as a cover on mobile phone screens, elevator buttons, door handles, etc.

Organic industrial wastewater is typically treated by using photocatalysts; but conventional photocatalysts require sufficient light, and wastewater is usually not very transparent, so the efficiency tends to be rather low. With this problem in mind, Wu's research team extracted silicon dioxide from rice husks, then added molybdenum and sulfur. The result is a quartz composite material which can be injected into a factory's wastewater pipeline, wherein the pressure generated by the water flow purifies the pollution without needing any light.

This new type of quartz composite piezoelectric material can also cope with the difficult-to-treat dyes present in the waste water produced by textile factories. Prof. Wu demonstrated this by pouring some quartz powder into a beaker of water colored with various dyes, mixing it in by gently agitating the beaker; within a few minutes, the water is clear and transparent.

Wu explained that what makes this new material so effective is the addition of molybdenum and sulfur during the production process, such that pieces of molybdenum disulfide grow on the quartz rod, which takes on the appearance of a mace, thereby increasing the contact area between the material and the sewage, and making the treatment more efficient.

Wu emphasized that in addition to wastewater treatment, this material can also be used to produce hydrogen, which can be collected and used to produce energy; in addition, piezoelectric materials are reusable and biodegradable, providing a type of wastewater treatment which is cheap, convenient, effective, and environmentally friendly.

The research team's work has recently been featured in the top international journals *Advanced Materials* and *Advanced Functional Materials*, and their quartz composite material has already received patents in Taiwan and the United States.

Wu was born in a farming village of Fangyuan in Changhua County, where he grew up assisting his father in the rice fields. The rice husks were fed to the chickens or pressed into panels, but Wu always wondered if they might somehow be put to better use. After becoming a researcher in materials science, he began



ⓐ A research team led by Prof. Wu Jyh-ming of the Department of Materials Science and Engineering has recently developed two composite piezoelectric materials extracted from common waste products.
The research team (left to right): Ho Pinyi, Wu Jyh-ming, and Lai Sinian.
ⓑ Ho holding up a mobile phone with a self-sanitizing cover produced from a material made by extracting chitin from squid bones.
ⓒ Wu in the lab scooping up some rice husks.
ⓓ Wu (right) with his father in the paddy fields.
ⓔ Wu in the lab with a handful of the rice husks.

using large quantities of rice husks in his experiments, and one day, realizing that 200-300 grams of silica can be extracted from each kilogram of rice husks, he wondered if they could be used to make a new type of piezoelectric material. Wu's latest discovery was especially welcome to Wu's 82-year-old father, who still works in the rice fields on a daily basis.

Comparison of new composite piezoelectric material and traditional photocatalysts

	New composite piezoelectric material	Traditional photocatalysts
Wastewater decomposition rate (liter / mole / minute, average)	8	0.08–2
Hydrogen production (micromole / gram / hour, average)	6000	1000–3000
Environmental friendliness	excellent	normal
Means of generating electric charge	pressure or stirring	light

Wu's research team has also succeeded in extracting chitin from squid bones, and using it to produce a new composite piezoelectric material which can be made into a transparent film that can self-sterilization whenever it's touched, making it highly suitable as a screen cover for various items in public places, such as automated ticketing machines.

She said that the chitin used to make this new piezoelectric material can also be extracted from shrimp shells, crab shells, and cuttlefish bones, and that it can also be manufactured using bionic technology. This transparent film is well suited for screens that can be damaged by spraying alcohol, such as those used on mobile phones.

When Ho's family learned about her work in the lab, they decided to help out by regularly making various types of dishes featuring squid, and providing her with all the transparent bones. As a result, every time she visits her family, her mother gives her a big bag of squid bones to take back to the lab.

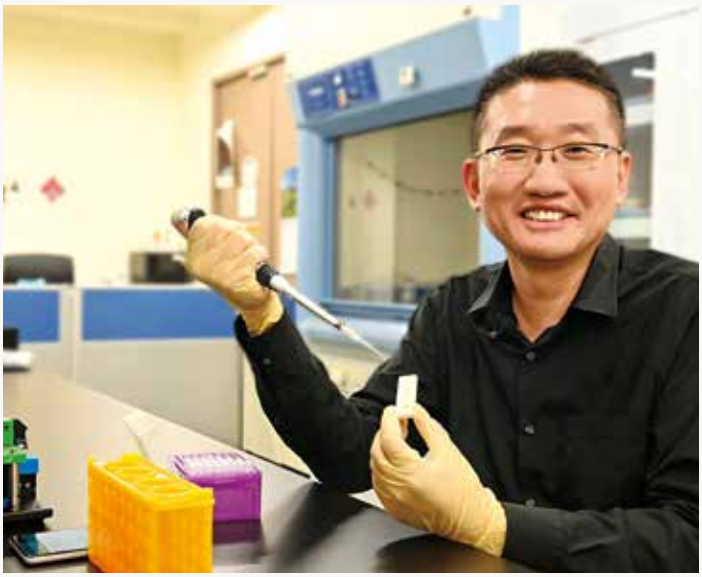
A RAPID TEST KIT FOR POTENTIAL SEVERE COVID-19 CASES

Prof. Cheng Chao-Min of the Institute of Biomedical Engineering at NTHU has recently developed a new covid-19 rapid test kit which allows the physician to provide timely treatment to high-risk patients, thereby making more efficient use of such critical equipment as respirators.

Developed in collaboration with the Tri-Service General Hospital, the prototype is currently under the clinical validations at a number of medical centers, and Cheng has applied for an emergency use authorization of US Food and Drug Administration.

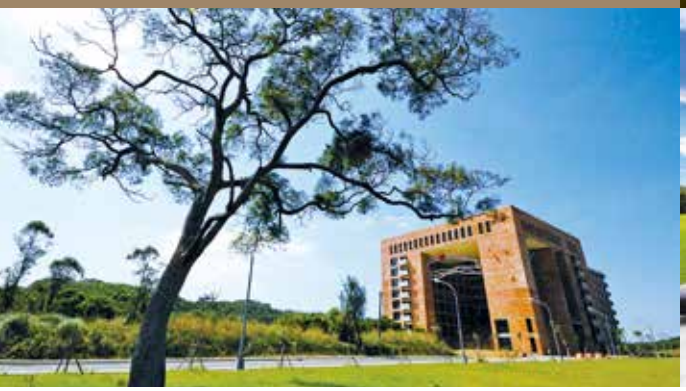
Rapid testing saves lives

According to Cheng, some covid-19 patients initially have only flu-like symptoms, but within a few hours the condition could suddenly becomes severe. At present, the prognosis of covid-19 patients is mainly based on the presence of such symptoms as dyspnea (difficulty breathing), and the laboratory tests currently available require at least one or two days to complete, during which time a patient's condition can rapidly deteriorate.



Prof. Cheng Chao-Min of the Institute of Biomedical Engineering demonstrating the use of the covid-19 rapid test kit developed by his research team.

Prof. Cheng indicated the key in the diagnosis of Covid-19 is the cytokine interleukin-6 (IL-6) concentration in the patient's serum; soon after infection with the SARS-CoV-2 , the person's immune system begins to resist it, failing which, the immune system collapses, causing the production of a large amount of cytochrome, resulting in a "cytokine storm," which is the actual cause of death in many covid-19 cases. Some covid-19 patients enter the hospital in relatively good health, but their condition could soon deteriorates. Thus the need to measure the IL-6 level in serum so as to quickly determine which patients require immediate treatment with either the endotracheal intubation or the respirator.

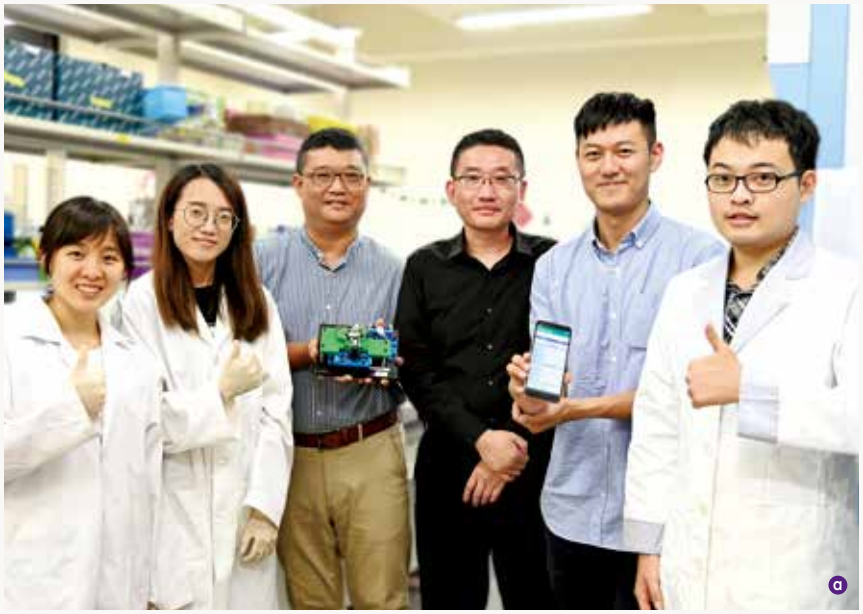


On the front-lines in the battle against covid-19

Cheng has demonstrated how the test is conducted by using a dropper to place a drop of serum containing high IL-6 concentration onto the white test strip about the size a person's finger; within two minutes two distinct red lines appear on the test strip, indicating that the patient's condition will soon become severe. If only one red line appears, it indicates that the patient's condition is mild.

A lack of respirators has significantly increased the covid-19 death rate in both the United States and Italy, hence the need to rapidly assess the severity of the patient's condition so that those at highest risk can be put on a respirator and administered anti-IL-6 medication as soon as possible; Cheng's test can also be used to quickly determine when a severe patient's IL-6 concentration has dropped enough to be taken off the respirator.

ⓐ Prof. Cheng Chao-Min of the Institute of Biomedical Engineering demonstrating the use of the covid-19 rapid test kit developed by his research team..
ⓑ Prof. Cheng analyzing the density of IL-6.
ⓒ Prof. Cheng and his research team.



NTHU TEAMS UP WITH TRI-SERVICE GENERAL HOSPITAL

As a concerted effort to give increasing emphasis to education and research in the field of medical science, NTHU is preparing to launch three new programs—a post-baccalaureate in medicine, and doctoral programs in precision medicine and the biomedical applications of artificial intelligence (AI)—and is joining forces with Taoyuan City to establish the Tsinghua University Hospital. In addition, the University is planning to offer program combining medical science and technology which will be open to all undergraduates.

On July 27th, President Hocheng Hong and Tri-Service General Hospital superintendent Tsai Chien-Sung signed a memorandum of cooperation outlining an ambitious plan for jointly conducting biomedical research in such areas as medical engineering, smart medicine, and AI diagnosis. The alliance with Tri-Service is one part of NTHU's ongoing expansion in the medical field, which includes establishing a post-baccalaureate program in medicine and an affiliated hospital in Taoyuan, expected to begin receiving patients by 2027.

President Hocheng said that NTHU originally focused on science and engineering, afterwards gradually expanding into the humanities, social sciences, education, and the arts. In recent years, however, the focus of expansion has shifted to the fields of biomedicine and the medical sciences, hence the memorandum of cooperation with Tri-Service General Hospital.

President Hocheng said that recent developments in medicine are largely the result of increasing cooperation between the fields of science and engineering. For example, researchers at NTHU and Tri-Service General Hospital have recently teamed

ⓐ NTHU president Hocheng Hong (left) and Tri-Service General Hospital superintendent Tsai Chien-Sung displaying the memorandum of cooperation.
ⓑ Hocheng (left) and Tsai Chien-Sung discussing the memorandum of cooperation.
ⓒ Hocheng introducing the NTHU representatives.

up to develop a reagent for use in a covid-19 rapid test kit, which provides results in about two minutes. The test kit has been sent to the US FDA and is being considered for emergency authorization.

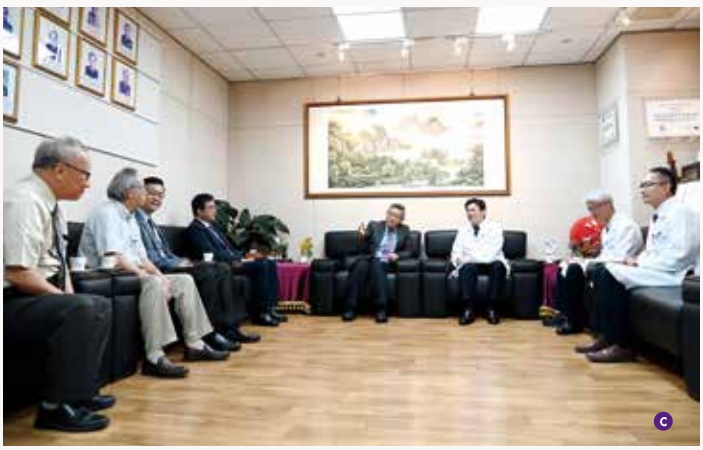
Hocheng said that one of the areas NTHU and Tri-Service are considering for joint research is the further development of cancer treatment using the Boron Neutron Capture Therapy (BNCT) already developed at NTHU. He also indicated that NTHU's affiliation with the military goes back to the Sino-Japanese War, during which time many Tsinghua alumni joined the war effort, the most famous of them was General Sun Li-jen. More recently, last year NTHU established the Military Science Group, an education center of Tsinghua College for training future officers set up in cooperation with the Ministry of National Defense.

Superintendent Tsai said that NTHU and Tri-Service have a long history of cooperation, and at one point a merger of the two was being considered, adding that this memorandum of cooperation will help to strengthen their joint efforts, especially in the areas of clinical medicine, teaching, and research fields.

Tsai said that NTHU is one of the top 100 universities in Asia, and has become internationally renowned for its research in the fields of science, engineering, and biomedicine. Moreover, the combination of Tri-Service's clinical experience and NTHU's expertise in biomedical research will make it possible to make major advances in such areas as precision medicine, high-throughput pathogen screening, ultra-analysis biomedical imaging, AI diagnosis, and new vaccines.

Tsai said that advances in medical technology are bringing about major improvements in medical treatment, and that biomedicine is currently one of the most important areas of medical research. What's more, he is looking forward to expanding the range of cooperation between NTHU and Tri-Service into additional areas of cutting-edge research.


b


c

JOINT RESEARCH CENTER ESTABLISHED BY NTHU AND ZHEN DING TECHNOLOGY

On June 18 NTHU and Zhen Ding Technology announced the establishment of a joint research center, with Zhen Ding investing NT$50 million over the next five years for research in such areas as printed circuit boards (PCB), advanced manufacturing processes, and advanced materials.

The center will be named the Tsinghua-Zhen Ding Research Center. Included in the plan is the renovation of a space in the old R&D building and turning it into the Zhen Ding Lecture Hall, which will serve as the classroom for the school's recently established Master's Program in Intelligent Manufacturing and High-level Management for Working Adults, featuring a number of courses taught by high-level managers at Zhen Ding.

At the signing ceremony, NTHU president Hocheng Hong said that the University has a long history of cooperation with industry, and has already established joint research centers with TSMC, MediaTek, and Delta Electronics. Undoubtedly, the teaming up with Zhen Ding—the world's leading PCB company—will be yet another win-win situation.

President Hocheng pointed out that in cooperation between academia and industry, the benefits go in both directions. He said that when he went to Germany to study many years ago,

At the signing ceremony (left to right): Zhen Ding director of human resources Yang Weichen, Charles Shen, Hocheng Hong, and NTHU senior vice president Tai Nyan-hwa.

Zhen Ding chairman Charles Shen (left) and NTHU president Hocheng Hong displaying the signed agreement.

industry-university cooperation was practically unknown in Taiwan, but his first-hand experience in Germany convinced him that it brings huge benefits to both parties. In particular, enterprises enjoy reduced risks and higher profits, and university students gain access to lots of valuable internship opportunities.

Zhen Ding chairman Charles Shen said that Tsinghua's research capabilities are among the best in Taiwan, and that many of his employees are Tsinghua graduates. Thus he is confident that long-term cooperation with Tsinghua will be a major boon for research and innovation in the PCB industry.

Shen said that Zhen Ding has rapidly expanded since being established in 2005, and today is a world-class enterprise with six large factories and 38,000 employees, adding that it has been ranked as the world's top manufacturer of circuit boards for three years in a row, beginning in 2017.

Chairman Shen further indicated that the circuit board industry requires specialists in a range of fields, including electrical engineering, chemical engineering, industrial engineering, materials science, and management, all of which are areas in which Tsinghua has strong programs. He also pointed out that the development of new materials is an important part of the development of the PCB industry, and that this is an area in which NTHU is particularly strong.

Also attending the signing ceremony was former Executive Yuan president Mao Chi-kuo, who predicts that the cooperation between Zhen Ding and Tsinghua will soon set the pace for industry-university cooperation.

Mao further explained that Zhen Ding is far ahead of its nearest competitor, and is now actively seeking new opportunities for growth. Moreover, the circuit board industry is presently being presented with a new wave of growth opportunities in

ⓐ President Hocheng said that NTHU and Zhen Ding Technology is a winning combination.
ⓑ Chairman Shen is looking forward to cooperating with NTHU long into the future.
ⓒ Former Executive Yuan president Mao Chi-kuo predicts that the cooperation between Zhen Ding and Tsinghua will soon set the pace for industry-university cooperation.

such areas as 5G, artificial intelligence, and electric vehicles. Thus, linking up with Tsinghua's strong R&D capabilities will enhance Zhen Ding's ability to make vital upgrades in terms of materials and smart manufacturing.

Now entering its second year, NTHU's Master's Program in Intelligent Manufacturing and High-level Management for Working Adults features classes taught by experienced professionals in conjunction with NTHU faculty from such departments as Industrial Engineering, Computer Science, Power Mechanical Engineering, and Electrical Engineering. The curriculum focuses on such areas as AI, big data analysis, deep learning, decision optimization, and the internet of things.

SAVING TAIWAN'S ENDANGERED FROG SPECIES

a The Frog House is already home to several native frog species.

b Longtime conservationist Li is in charge of NTHU's Frog House project.

Professor Li Chia-wei of the Department of Life Sciences has recently implemented a plan to protect Taiwan's endangered frog species. As part of the plan, NTHU has recently become the nation's first university with a "frog house," built with exclusive sponsorship provided by the president of Alumini Association, Mr. Tsai Jinbu.

Prof. Li said that nearly half of the frog species worldwide are threatened with extinction due to pollution and loss of habitat. Despite the ongoing efforts of a well-funded international program for frog conservation, since 1980 more than 120 species of frogs have gone extinct worldwide.

Li said that there are 36 species of frogs native to Taiwan, 14 of which are endemic. NTHU's Frog House project plans to include all 36 native species, beginning with Moltrecht's green tree frog (Rhacophorus moltrechti), which is endemic to Taiwan.

At the opening ceremony for the Frog House, Li said that it currently has 12 tanks and about 200 frogs. The second Frog House will have enough space for about 5,000 frogs and will propagate tadpoles for reintroduction into the natural environment.

Tsai Jinbu, President of Alumni Association said that it was last year when he learned about Prof. Li's plan to establish the Frog House at Tsinghua, whereupon he immediately offered to cover all the expenses, with full confidence that Li would do a good job.

Tsai also said that Prof. Li has been actively involved in plant and animal conservation for a long time, such that "In just six months the Frog House is up and running, and the best is yet to come!"

Li said that the only other frog conservation program currently operating in Taiwan is the one at the Taipei Zoo, and that is

At the opening ceremony (left to right): NTHU senior vice president Lyu Ping-chiang, Tsai Jinbu, Li Chia-wei, and Hsieh Hsinyi of the Conservation Research Center at the Taipei Zoo.

c Golden dart frogs (Phyllobates terribilis) at the Frog House.

d CProf. Li Chia-wei (right) of the Department of Life Sciences at the Frog House, set up with generous support from Alumni Association president Tsai Jinbu (left).

where he learned the basics of frog conservation, including how to design frog tanks and how to raise frogs. In addition, the Taipei Zoo provided the Frog House with three species of South American poison dart frogs, which have already successfully reproduced.

In addition to the South American poison dart frog and the Moltrecht's green tree frog, the Frog House also currently hosts such native species as the Swinhoe's brown frog (*Odorrana swinhoana*) and the brown tree frog (*Buergeria robusta*); moreover, there are plans to add a number of protected species, including the Taipei grass frog (*Hylarana taipehensis*) and the emerald tree frog (*Zhangixalus prasinatus*).

In addition to a tank which simulates their natural habitat, each species is provided with the type of food it normally eats. This is the job of Su Pei-chi, a research assistant of the Institute of Molecular and Cellular Biology, who feeds the frogs and turns on the sprinkler system to moisten the tanks at regular intervals.

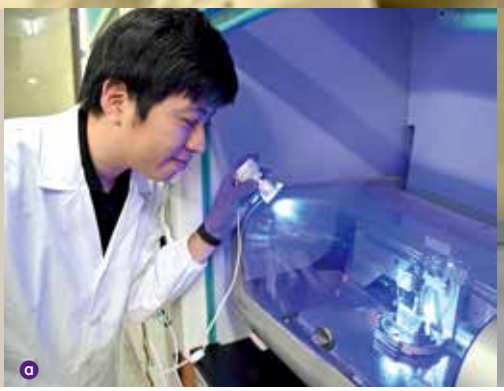
Su feeds the poison dart frogs with flightless fruit flies fortified with powdered calcium and vitamins. She explains that poison dart frogs are too slow to catch flying insects, whereas the Moltrecht's green tree frog is quick enough to catch fast-moving crickets.

Hsieh Hsinyi of the Conservation Research Center at the Taipei Zoo said that the Zoo's cooperative relationship with NTHU goes back to 2015, when the Zoo, NTHU's College of Life Science, and the Cecelia Koo Botanic Conservation Center signed a letter of intent for conservation cooperation.

Hsieh said that when the Taipei Zoo set up a pangolin pavilion last year, Tsinghua teamed up with the Cecelia Koo Botanic Conservation Center in providing about 2,400 plants belonging to more than 300 species to simulate the habitat of a tropical rainforest, adding that the Zoo is looking forward to increasing cooperation with Tsinghua in the future.

e Moltrecht's green tree frog (*Rhacophorus moltrechti*), which is endemic to Taiwan.

f The Frog House is already home to several native frog species.



NTHU RESEARCHERS MAKE MAJOR BREAKTHROUGH IN QUANTUM DOT TECHNOLOGY

a Team member Ho Shih-jung of the Department of Materials Science and Engineering.
b Team leader Chen (right) with team member Ho (left).

You probably already know that placing a pared apple in saltwater prevents it from turning black from oxidation, but do you also know that saltwater can also be used to protect fragile quantum dot material? A research team led by Prof. Sean Chen of the Department of Materials Science and Engineering has recently developed the world's first quantum dot material using saltwater as a coating, which not only resists water and oxygen corrosion, but can also be uniformly printed as a micro LED on flexible plastic film for use in high-resolution mobile phones, glasses, etc.

The team's research has been published in a recent issue of *ACS Applied Materials & Interfaces*, and the material they have developed is currently being patented in the United States and Taiwan.

Eager to develop displays which are high-resolution, high-brightness, ultra-thin, flexible, and long-life for use in the goggles used in augmented reality (AR) and virtual reality (VR), and for watches and other wearable electronic devices, Apple, Samsung and other major panel manufacturers have invested heavily in the research and development of micro LEDs to replace the current OLEDs.

But arranging millions of LED dots less than 100 microns in size onto a substrate is no easy task. According to Chen, many manufacturers use a stamping method to move millions of red, green, and blue micro LEDs one by one to the substrate, but if a few small dots don't stick, the screen will be marred by dead pixels.

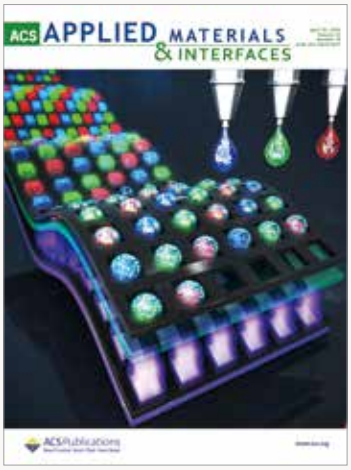
One way of solving this problem is to use inkjet printing to arrange the micro LEDs, which is more efficient and cost effective. However, once the quantum dot solution is printed, convection occurs inside the droplet, pushing the material to the

periphery, leaving it unevenly distributed, similar in appearance to the lighter center and darker periphery seen in a drop of coffee dropped onto a light surface, the so-called "coffee ring phenomenon."

By adding salt water (a sodium chloride solution) to the quantum dot solution, Chen's research team successfully coated the quantum dots, which formed into crystals, what Chen describes as "grabbing hold of the quantum dots and condensing them into a uniformly distributed dot." Such "coated" quantum dots are also more stable and corrosion resistant, like apples soaked in saltwater.

The team member who came up with the idea of soaking the quantum dots in salt water was Ho Shih-jung. He observed from photomicrographs that when quantum dot material without saltwater is printed, it scatters into irregular shapes, but by adding saltwater, they gradually shrink and converge into a uniform and beautiful crystal.

According to Ho, adding saltwater to the quantum dot solution also makes it possible to spray smaller droplets,



The Team's groundbreaking research has been published in a recent issue of ACS Applied Materials & Interfaces.

explaining that the droplet size of current quantum dot printers is about 30 to 50 microns, but by adding saltwater the size can be reduced to as small as 3.7 microns, which is about 1/20 the diameter of a human hair, and the resolution is even better.

c A research team led by Prof. Sean Chen of the Department of Materials Science and Engineering has recently developed the world's first quantum dot material using saltwater as a coating.

d The research team (left to right): M.A. student Chung Nienting, Ho Shih-jung, Sean Chen, and M.A. student Chuang Yilung.

NTHU RACING UNVEILS THIRD-GENERATION ELECTRIC RACECAR

Having established a strong reputation in international competitions over the past few years, on July 16 the student club NTHU Racing announced the completion of its third generation electric racecar, which can accelerate from 0 to 100 kilometers per hour in a mere 2.7 seconds. This is the first four-wheel-drive racecar built by students in Taiwan. This year's international competition was cancelled due to the covid-19 pandemic, and the team is now preparing for next year's event.

Dropping gasoline in favor of electric

Mainly composed of students at the Department of Power Mechanical Engineering, NTHU Racing also has members from the departments of Physics, Economics, and Chemistry, and

At its inception, NTHU Racing had only about a dozen members, but membership has gradually increased, and now stands at 50.

ⓐ Team captain Chen Zijing developed the racecar's battery system.
ⓑ NTHU Racing assembling their electric racecar.
ⓒ The team's driver is Chiu Chingyu.

the club has been competing in the Formula SAE competition held in Japan since 2015. Their first two entries ran on gasoline, but in 2018 they switched to the electric-powered division, and came in fourth place; last year their second-generation electric racecar came in second place, and now their sights are firmly set on winning first place in the electric division.

Team captain Chen Zijing said that NTHU Racing spent about one year designing and building it's third-generation electric racecar, during which time they redesigned the batteries, chassis, aerodynamics, and brakes. By switching to a high-density ternary lithium battery, which reduced the weight of the battery box from 75 kg to 55 kg, and by adding a third shock absorber, they have come up with a racecar which is lightweight, fast, stable, and highly maneuverable.

Made in Taiwan

Another feature of this third-generation electric racecar is that it was completely made in Taiwan, including the high-performance motor sponsored by ADATA Technology, unlike its predecessors, which used some imported parts.

Chen said that it's difficult to compete with Europe and the United States in the production of a gasoline engine, since they've been at it for so long, but when it comes to electric motors, Taiwan is already a frontrunner in cutting edge technology, adding that he's heard that the Student Formula competitions in Europe are planning to drop the gasoline engine division from this year's events, indicating that electric motors are the trend of the future.

In their first three years competing in the gasoline-engine division of Student Formula Japan, NTHU Racing's highest ranking was 21st. However, in 2018 they entered the electric division for the first time and came in fourth place, providing a major boost in morale. Another source of confidence was

Taking a test drive on campus.

the fact that lots of the Japanese teams had received technical guidance from large car manufacturers, resulting in designs differing only in various details; by contrast, NTHU Racing basically built its entry from scratch, using a process of trial and error which, when based on a solid foundation, leaves relatively more room for making major improvements.

Future challenges

Dubbed "TH05," the team's recently completed electric racecar is on par with Tesla's electric sports car, which can accelerate from 0 to 100 kilometers per hour in 2.6 seconds.

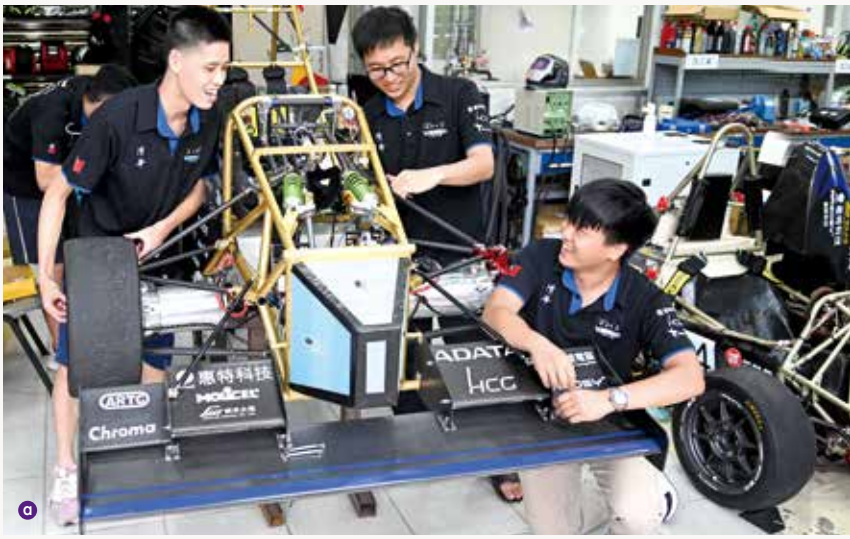
Not content with speed alone, NTHU Racing is now planning to develop an unmanned vehicle, a project which is being led by team member Hsieh Shenghan, a master's student of the Department of Power Mechanical Engineering. Nicknamed "Mr. Magic," Hsieh played a leading role in the development of TH05's electrical system.

Developing the electrical system

Something of an eccentric genius in the eyes of his younger classmates, Hsieh began his undergraduate studies in the Department of Physics, during which time he took lots of electives in other departments in accordance with his interests, but never completed a number of required courses, as a result he never graduated. Nonetheless, his grades were so good that he still managed to gain special admission to the Department of Power Mechanical Engineering's M.A. program. Hsieh joined NTHU Racing in his sophomore year, and has been an active member ever since.

Hsieh has played the leading role in developing the electric racecar's battery system and motor drive; whenever he gets stuck, he quickly finds a solution, and never misses an opportunity to learn something new.

As Hsieh sees it, relying on a manufacturer for the core technology of an electric vehicle speeds up initial progress, but leaves little room for further development, so overall it's better



ⓐ NTHU Racing team members (left to right): Chiu Chingyu, Hsieh Shenghan, and Chen Zijing (captain).
ⓑ Team member Hsieh Shenghan developed the racecar's electrical system.

NTHU Racing's TH05 is the first four-wheel-drive racecar built by students in Taiwan.

to take a DIY approach and start from scratch. The same goes for developing an unmanned vehicle, which Hsieh is confident the team will be able to pull off.

A multi-talented team

At its inception, NTHU Racing had only about a dozen members, but membership has gradually increased, and now stands at 50. Located behind Engineering Building I, the team's workshop is often bustling with activity late at night.

The team's driver is Chiu Chingyu. He is 173 cm tall and has to keep his weight within 52 kg, since even a single extra kilogram would affect the racecar's performance.

Team Captain Chen said that the team is very grateful for the school's support, and for all the expert guidance provided by team mentor Professor Lin Chao-an, who knows how to give students a lot of freedom and space, but is always ready to lend a hand when necessary, especially when it comes to fundraising.

Specifications for NTHU Racing's TH05	
Drive type	four-wheel drive
Speed: 0–100 km/h	2.7 seconds
Horsepower	160 hp
Torque	160 kg-m
Voltage	430 v
Battery capacity	7.26 kWh
Reduction ratio	11.01
Weight	303 kg
Maximum torque	352 N-m per wheel
Wheelbase	1560 mm
Axle track	front wheel: 1270 mm
	rear wheel: 1220 mm
Suspension	front: double A-arms with anti-tilt bar
	rear: double A arms
Tire size	205/470 R13
Brake type	four-wheel disc brake
Disk size (diameter)	"front: 220 mm
	rear: 200 mm"

NATIONAL TSING HUA UNIVERSITY WELCOMES INTERNATIONAL STUDENTS

For information on Admission and Financial Aids, please visit our website at http://oga.nthu.edu.tw/index.php?lang=en# or contact
Ms. Hui-Chen Chan, Division of International Students, Office of Global Affairs.
Email: hcchan@mx.nthu.edu.tw
Tel: +886-3-5162461
Fax: +886-3-516-2467
Office hour: 8:30AM -5:00PM, Monday through Friday (Taiwan time)

Application Timeline:
Degree Student
Fall Semester Application Graduate Program: January 1~March 15
Undergraduate Program: November 15~February 15
Spring Semester Application: August 15 to October 16

Exchange Student
Fall Semester Application: February 1~ April 15
Spring Semester Application: September 1~November 1

NATIONAL TSING HUA UNIVERSITY NEWSLETTER
101, Section 2, Kuang-Fu Road, Hsinchu 30013, Taiwan R.O.C.
TEL：03-5715131 · E-mail：web@cc.nthu.edu.tw · http://www.nthu.edu.tw/
PUBLISHED BY OFFICE OF THE SECRETARIAT

PUBLISHER : President Hong Hocheng
EDITOR : Prof. Chung-Ta King
EXECUTIVE EDITOR : Prof. Chung-min Chen

EDITORIAL BOARD : Prof. Sinn-Wen Chen, Prof. Nyan-Hwa Tai, Prof. Shih-Chang Shin, Prof. Ping Chiang Lyu, Prof. Jyun-Cheng Wang, Prof. Fang-Gang Tseng
EDITORIAL ASSISTANT: : Ya-hui Chen