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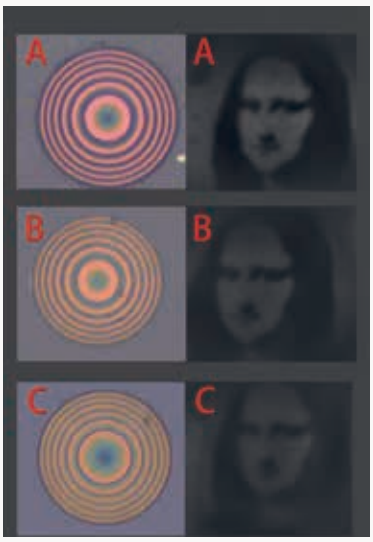
GROUNDBREAKING LENS TECHNOLOGY DEVELOPED AT NTHU

A research team led by Assistant Professor Liu Chang-Hua of NTHU's Institute of Photonics Technologies has made a major breakthrough in the miniaturization of lenses. Collaborating with a research team at the University of Washington, the team has developed a super-planar lens which uses tens of thousands of nano-pillars arranged in concentric circles to engineer the phase shift of lightwave. Moreover, the lens is thinner than a sheet of paper and can even be peeled off like a sticker and attached elsewhere. It is expected to be used as cameras lenses, mobile phones, and minimally invasive surgical catheters.

Their invention of the world's thinnest dielectric super-planar lens has been featured in the top journal *Nano Letters*, and has received considerable attention from foreign media.

A conventional lens is made of a piece of glass a few millimeters in thickness that has to undergo an expensive process of burnishing and polishing. Liu said that in the past few years multiple breakthroughs were made in nanotechnology and nano-optics, resulting in the development of dielectric super-planar lens (i.e. metalens). Such lens was typically realized by an array of nano-pillars based on SiO2, TiO2 or Si3N4 to engineer the phase shift of lightwave. However, the fabrication is quite challenging and those nano-pillars are very delicate, as the height of the pillar constituting the lens is at least 5 times its diameter (i.e high aspect ratio).

By employing innovative optical design methods, however, Liu's team can reduce the height of these pillars to the nanometer level so that the height of the pillar is only 2 times of the diameter. The shorter pillar is easier to manufacture, and lenses made with it are lighter and thinner. Thus, the



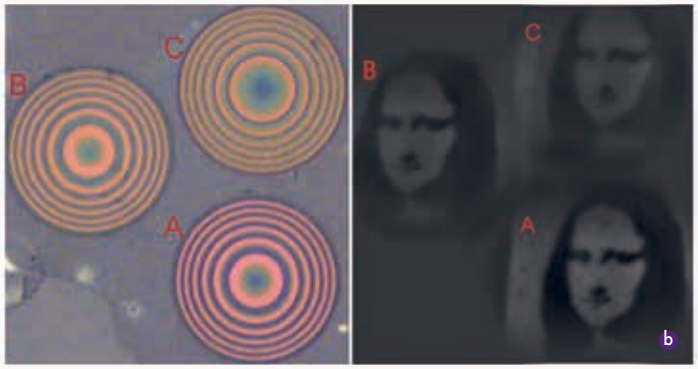
Different arrangements of the nano-pillars have different levels of clarity.

thickness of developed lens can be reduced to approach ~190 nm, one-hundredth that of a human hair, setting a world record for the thinnest dielectric planar lens.

Another breakthrough of this innovative work was the use of Van der Waals materials to make nano-pillars for the first time. Liu explained that Van der Waals materials are similar to the graphite used in pencils, which is formed by stacking layers of monoatomic layers connected by a weak Van der Waals force; thus the graphite readily takes to the paper, and can be easily erased.

Liu's team is currently using electron beam microscopy to make super-planar lenses in the laboratory, and has shown that these planar lenses can be useful for imaging applications. However, because thousands of nano-pillars have to be lithographically patterned one by one, the production speed is relatively slow. Liu said that if this technique is adopted by industry, it will be possible to produce such a lens in a few seconds by using the stepper and transparent media adapter (TMA) currently employed in the semiconductor manufacturing process.

Liu said that in addition to such applications as cameras, mobile phone lenses, magnifying glasses, spectacles, and



a Prof. Liu holding a sample of the thinnest lens.
b Liu's new type of super-planar lens uses such semiconductor materials as silica to make micron-scale pillars which can be arranged in concentric circles.

sunglasses, in the future this lighter and thinner lens may also be used to miniaturize various other instruments made up of many lenses, including eyepieces, object lenses, reflectors, and microscopes, and might even be used in tiny medical robots for drilling into human blood vessels.

After graduating from NTHU's Department of Power Mechanical Engineering Liu went to the United States to obtain a Ph.D. in Electrical Engineering at the University of Michigan. He has also conducted postdoctoral research at the Department of Materials Science and Engineering at Northwestern University and the Department of Physics at the University of Washington. Although he was offered a teaching position at a well-known foreign university, he decided to return to Taiwan to teach at NTHU. He said that living in Taiwan has a certain appeal and that the research environment has a lot to offer young professionals, such as Taiwan's thriving semiconductor industry. "Of course, being close to my family is the most important thing," he said with a smile.

Chen Jiaxin (right) is a master's student in the Institute of Computer Science and Hsu Zunlin (left) is a sophomore of the College of Electrical Engineering and Computer Science.

AI EDUCATION AT NTHU GOES INTO HIGH GEAR

In light of the growing importance of artificial intelligence (AI), NTHU has recently launched a number of campus-wide new courses in AI, including a 19-credit module for non-science and engineering students titled "AI Application Basics," and a 21-credit module for science and engineering students titled "AI Advanced Applications." Moreover, the Department of Computer Science is recruiting ten students for a new specialization in AI for the coming semester.

President Hocheng Hong said that at NTHU AI also stands for "added intelligence," in the sense of interdisciplinary knowledge, and emphasized that expertise in AI is rapidly becoming an essential professional skill in practically all fields, and is especially important for the policy makers of the future.

AI Application Basics focuses on programming and machine learning, and also includes courses in computer vision, image processing, digital audio, biological data analysis, robotics, and even introductory courses on the application of AI in music and literature. AI Advanced Applications includes elective courses in cloud computing and graphics theory.

President Hocheng hopes that in the near future over half of the students at NTHU will choose to take one of these AI modules.

Concurrent development of AI software and hardware

Prof. Fred Huang, dean of the College of Electrical Engineering and Computer Science, has previously led a research team which has developed various technologies used in "precision agriculture," including drones, satellite aerial photography, and image analysis, which together can be used to determine the best harvesting period and accurately predict the size of the harvest. Huang said that what's special about AI research at NTHU is that both the software and hardware are being concurrently developed—a dual skill which is a big advantage when students enter the job market—and the way in which the College of Electrical Engineering and Computer Science cooperates with various other NTHU colleges to broaden the application of AI.

Wang Ting-chi, the director of the Department of Computer Science, said that he recently participated in an international seminar on electronic design automation, and noticed that one-fourth of the papers were related to machine learning, adding that large companies in Taiwan and abroad urgently need AI experts. Thus the Department of Computer Science has decided to set up a new specialization in AI, in addition to its existing specializations in electronic information and information engineering.

Faculty of the College of Electrical Engineering and Computer Science (left to right): Wang Ting-chi, Fred Huang, Liou Jing-jia, and Wang Chun-yao.

"Twenty years ago, we used to say that 'programming is the future,' but now we are saying that AI is the future," commented Liou Jing-jia, currently the director of the Department of Electrical Engineering, adding that machine learning is developing at such a rapid pace that in the near future writing programs will mostly be done by computers. He also pointed out that in the past few years the courses offered by the College of Electrical Engineering and Computer Science in AI related subjects have been fully enrolled, and these new courses in advanced AI are intended to better meet the educational needs of students.

AI needs more women

At present, the proportion of female students in the various departments of the College of Electrical Engineering and Computer Science is less than one-quarter of the total, which is unfortunate, since women are usually better than men in teaching machines to think like humans. Liou also said that he requires the students in his Embedded Systems course to design a self-driving system, and that women always do it better than men.

Liou also said that lots of women are actually very interested in AI. Not long ago he and some of his colleagues gave a talk on AI at the Municipal Taichung Girls' Senior High School, and the students posed a lot of good questions on such issues as will robots making human workers redundant? how to get along with robots? and the legal status of robots. He was very impressed and hopes that more women will go into AI research.

Pushing the AI envelop

For the past two years Prof. Soo Von-wun of the Department of Computer Science has been teaching a course titled "Introduction to AI in Music" in which students learn how to teach computers to compose music and lyrics. He believes that before long computers will be a lot better at singing and expressing human feelings. In addition to students from his own department, his course has also been taken by a number of students from the Music Department, and this kind of cross-disciplinary cooperation is accelerating the pace of progress.

Soo has also offered a course titled "AI in Literature" focusing on how to program computers to produce various types of writing, including reports, novels, scripts, and even poems and jokes. He said that while the poetry written by a computer is still quite stiff, based on the current speed of development, it may soon be impossible to distinguish between poetry written by a computer and poetry written by a real person. Both of these courses are highly popular.

Learning through international exchange

In addition to providing a wide array of AI courses, the College of Electrical Engineering and Computer Science also helps its students to gain practical experience and to cultivate an international perspective. For example, it provides generous funding for study-abroad programs for either summer vacation or an entire semester; the Department of Computer Science has a similar program.

a The College of Electrical Engineering and Computer Science is spearheading NTHU's increasing emphasis on AI education.

b Wang Chun-yao (second from right) visiting his exchange students at the University of Minnesota.

Wang Chun-yao, the director of the undergraduate program of the College of Electrical Engineering and Computer Science, said that his department organizes advanced study programs for students during summer vacations. For those who have just finished their freshman year, there is a six-week exchange program with Tsinghua University in Beijing; those who have finished their sophomore year can do an internship; and for those who have finished their junior year there is a special program preparing students to spend a semester abroad in the United States. The College also offers eight scholarships, each worth NT$260,000.

Huang said that all the compulsory courses of the College of Electrical Engineering and Computer Science are taught in two versions—English and Chinese; students are free to choose, and sometimes more students sign up for the course taught in English, adding that strong foreign language proficiency is essential for making the most of any study abroad program.

On the interface of gaming and AI

Chen Jiaxin, a recent graduate of the College of Electrical Engineering and Computer Science, said that she completed all the coursework for her bachelor's degree in just three years, and then went to the United States to study for one semester at the University of Minnesota. Having graduated in three and a half years, she is now a master's student in the Institute of Computer Science and specializes in computer vision processing. Chen said that she has greatly benefited from the outstanding teachers and rich learning resources at NTHU. During her semester at the University of Minnesota, in addition to completing courses in such areas as communications and computer graphics, she also took classes in theater and ice skating, and found studying in a multicultural environment to be both enjoyable and stimulating.

Hsu Zunlin, a sophomore of the College of Electrical Engineering and Computer Science, is a member of the team which won last year's intercollegiate championship in the popular online game League of Legends (LoL); he has become so well known that while student-teaching at a local high school as part of his coursework, some of the students recognized him. Hsu may look like a slacker, but he's actually at the top of his class.

Hsu said that during junior high school he was rather obsessed with LoL, but by the time he entered senior high school he had learned how to properly manage his time so as to maintain a proper balance between classwork and gaming; these days, he never plays online games when he has a class the next morning. He said that NTHU is rich in interdisciplinary resources, and suggests that those interested in working in the online game industry should consider taking courses in such areas as theater, music, and art design.

Prof. Lai Chih-huang (left) of the Department of Materials Science and Engineering and Prof. Lin Hsiu-hau of the Department of Physics using hand gestures to represent the "0-1" concept in digital memory.

NTHU RESEARCH TEAM AT THE CUTTING EDGE OF MEMORY RESEARCH AND DEVELOPMENT

From mobile phones to computers, wearable devices, the Internet of Things, and smart city operations, data processing and storage are the core of digital technology. At present these functions are mainly carried out using dynamic random access memory (DRAM), but this consumes power and can't easily be further reduced in size. However, a research team led by Prof. Lai Chih-huang of the Department of Materials Science and Engineering and Prof. Lin Hsiu-hau of the Department of Physics has made a revolutionary breakthrough in the development of the next generation of digital memory known as magnetoresistive random access memory (MRAM), which allows for faster reading and writing, uses less power, and retains data even when there is a power outage.

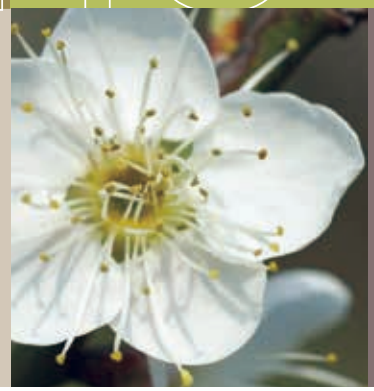
Lai (center) and Lin (right) with team member Lin Bohong, a doctoral student of the Department of Materials Science and Engineering.

Their research has been published in a recent issue of *Nature Materials*, and has had an impact factor of 39.2. With the support of the Semiconductor Moonshot Project of the Ministry of Science and Technology, their research is expected to make a major contribution to the domestic memory industry.

Reducing size and energy consumption with MRAM

Prof. Lai explained that DRAM uses the electrical charge of electrons; the presence of the charge is represented as "1," its absence as "0," and maintaining this information requires a continuous power supply. As for size, DRAM originally conformed to Moore's Law, which states that size is reduced by half every 18 months. However, as the components became smaller, DRAM began to gradually deviate from Moore's Law, and is now hard to shrink any further.

Lai believes that when Moore's Law becomes inoperative, this signals the advent of the era of spintronics. This was the insight that led to his cooperation with Lin.



Prof. Lin explained that in addition to carrying an electric charge, electrons spin, thereby generating a tiny magnetic moment similar to the millions of tiny magnets on a wafer, with the memory of 0 and 1 being determined by direction of the magnets' pole. Thus it is not necessary to supply power when it is not operating, and even if there is a power outage, the data will not disappear. It is expected that the use of MRAM can at least double the standby time of mobile phones and tablets.

Lin said that the structure of magnetic memory is like a sandwich. The upper layer is a freely flipping magnet, which can process the data quickly; the bottom layer is a fixed magnet which is responsible for storing the data; and these two layers are separated by an oxide layer. When the magnetic moments of the two magnets are in the same direction, the spinning electrons easily pass through, forming a low resistance represented as 1; when the magnetic moments are opposite there is high resistance, represented as 0.

However, these small magnets become unstable at room temperature due to thermal energy. Scientists have found a way to add an antiferromagnetic layer which fixes the direction of the magnetic pole, but this solution also interferes with the switching necessary for the wafer to carry out its functions.

A major breakthrough in electron spin current

To solve this problem, Lai and Lin formed an interdisciplinary team with doctoral students Lin Bohong and Yang Boyuan. After a long series of experiments, they solved the problem by adding a layer of platinum, which is only a few nanometers thick and uses the coupling effect of the spin-orbit to generate a spin current, allowing for quick and accurate switching of magnetic moments during writing while the magnet remains fixed in place at other times.

"It's like putting a little spin on a bowling ball," explained Lai. But if it's that simple, why hasn't anyone thought of it before? Indeed, the team had considerable difficulty in convincing the international scientific community of the validity of their results, and it was only after providing ironclad evidence that *Nature Materials* finally accepted their groundbreaking paper in the field of spintronics.

Opposite yet complimentary

In recent years NTHU has been promoting cross-disciplinary cooperation, such as the research conducted by the physicist Lin and the materials expert Lai, who have learned to work together seamlessly.

Their research often begins with Lin putting forward a possible solution to some problem from the point of view of physics, and then asking Lai if his solution is feasible from the perspective of materials science. This approach has also been adopted by their graduate students, who have set up a communication platform for finding innovative solutions to key problems in science and engineering.

However, in terms of personality, Lin and Lai are polar opposites. Lin says that he is good at coming up with new ideas, but not at bringing them to realization, but,thanks to

Lai's rigorous attitude and attention to detail that their research has borne fruit. Lai describes Lin as a brilliant thinker with an uncanny ability to make physics amazingly interesting.

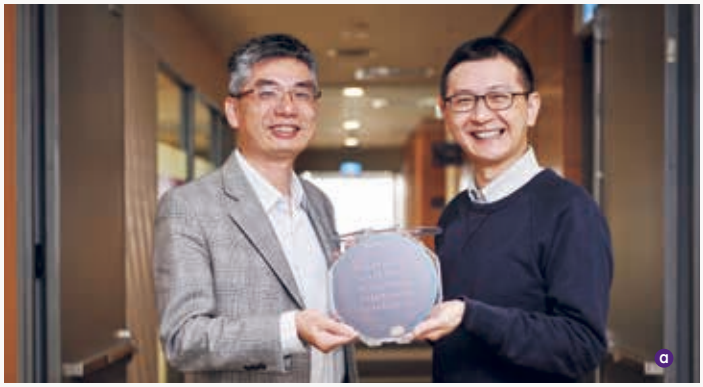
Lai and Lin have been working together for ten years. They often get together on holidays, and occasionally even use Line to share the flashes of insight that sometimes occur in the middle of the night. Thus Lin jokes that both of their wives are starting to get jealous.

Since they began their joint research in 2009 their work has become increasingly influential. The impact factor of their first joint research article was a mere 3.8, while that of their second and third articles was 7.2 and 21.9, respectively.

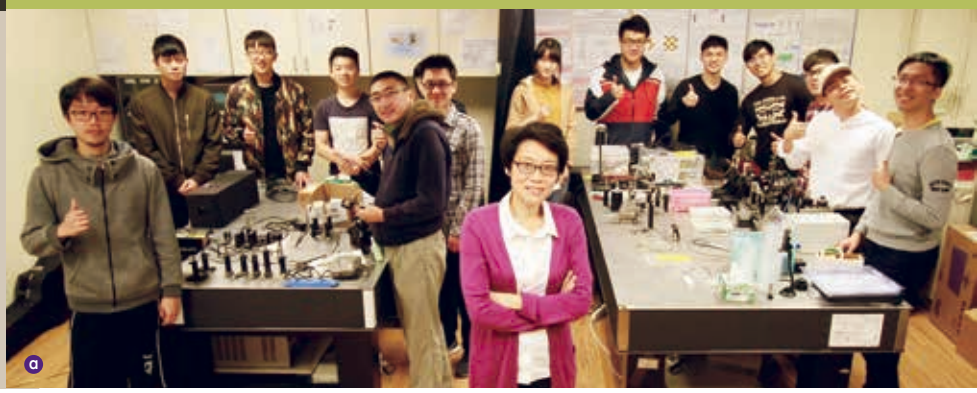
Lin Bohong, a doctoral student of the Department of Materials Science and Engineering, is the first author of this paper. He said that being on a research team led by two professors who are very different from one another has been a highly valuable experience, and that he is especially thankful to his advisor Prof. Lai for teaching him how to do solid research and also for sending him to France, Ireland, Singapore and other places to participate in seminars to expand his horizons through international exchanges. Lai has also arranged for Lin Bohong to spend a year abroad conducting magnetic research.

In recent years a number of major international companies have begun to conduct research in MRAM development, including Samsung, Intel, and TSMC. It's likely that mass production of high-density MRAM will begin sometime this year, a development in which the research team led by Lin and Lai has played a key role.

The research team is presently working on applying their groundbreaking discovery to other structures, and their ongoing findings are expected to have a major influence on the development of the domestic memory industry. Moreover, with the increasing prevalence of artificial intelligence, wearable devices, and the Internet of Things, the market for magnetic memory will grow rapidly. In Lai's view, the development of MRAM technology is going to have a decisive influence on the competitiveness of Taiwan's semiconductor industry.



a Although very different in terms of personality, Lai (left) and Lin work together seamlessly.



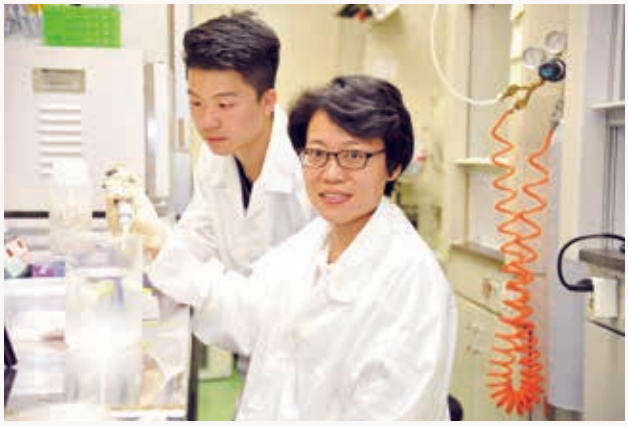
A research team led by Prof. Hung Yu-chueh of the Department of Electrical Engineering has developed the world's first light-sensing DNA nano-composite technology.

NTHU RESEARCH TEAM DEVELOPS NEW DNA MATERIALS TECHNOLOGY

The sensors that are an integral part of the Internet of Things and the solar cells needed for green energy may soon be made of DNA-based materials. A research team supported by the Ministry of Science and Technology and led by Prof. Hung Yu-chueh of the Department of Electrical Engineering and the Institute of Photonics Technologies has recently used DNA extracted from fish to produce photoelectric materials. The team has also developed the world's first light-sensing DNA nano-composite technology, which has been used to establish the only natural DNA material processing platform in Taiwan. It is expected that this new material will one day replace petrochemical materials and be used in optoelectronic components.

Hung said that due to resource depletion and environmental pollution, many industries are looking for ways to reduce their dependence on petrochemicals by making more use of bio-matrix-based materials, which have the advantages of being natural and sustainable. For instance, Coca-Cola has begun to use bottles made of a material extracted from sugar cane.

Hung said that at present most photoelectric components, such as sensors and solar cells, are mostly made of semiconductor materials, but few people realize that they can also be produced with DNA molecules. "In fact," said Hung, "DNA is abundant and easy to obtain, yet its applications are just beginning to be developed."



Hung's research team has established the only natural DNA material processing platform in Taiwan.

Reducing costs and energy consumption

Hung said that the first step in the development of this technology is obtaining DNA. After the research team obtained DNA from fish eggs and fish milt, the DNA was extracted by homogenization, purification, alcohol precipitation, and other techniques. To make use of the unique properties of DNA, the team developed a series of new surfactants for modifying DNA molecules. They have also developed innovative processes which can be used in the manufacture of nano- and micro-scale optical films, optoelectronic components, and sensors.

Hung explained that DNA is like the host who is in charge of the seating arrangement at a banquet, and molecules are like the guests. Guided by the host's double-helix structure and different functional groups, the guests automatically take certain seats. This feature can improve component efficiency and greatly advance research and development in such fields as laser technology and solar cells.

The team's work on light-sensing DNA and nano-composite technology has been reported in international journals and other media. Hung said that this low-cost, low-energy technology has already received patents in the US and Taiwan, and that its industrial applications are currently being developed.

Starting from scratch

As a doctoral student at the University of California, Los Angeles, Hung mainly researched optical communications and high-speed transducers. After she began teaching at NTHU, faced with a paucity of research materials and instruments in these areas, she began to explore new research topics, and developed a strong interest in using DNA to make electronic components. But at that time nobody in Taiwan had done research in that area, nor did she have a background in DNA and material synthesis.

"For me, undertaking this kind of research really needs to start from scratch," says Hung, whose daring approach has led to a major breakthrough. At the end of last year she won the Wu Ta-you Memorial Award from the Ministry of Science and Technology for her ground-breaking work spanning the fields of biochemistry, materials, chemistry, nanotechnology, and electrical engineering.

A talent for interdisciplinary research

In order to confirm whether DNA can be used as a material for making optoelectronic components, in addition to extensive reading of the related literature, Hung and her research assistants visited various labs in Taiwan, and also began conducting joint research with the Department of Chemical Engineering and Biotechnology at Cambridge University and the Materials and Manufacturing Directorate of the United States Air Force Research Laboratory. She said that discussing problems with experts in different fields stimulates new ways of thinking.

Hung said that she is very grateful to her students who learned the techniques of extracting biological DNA and material synthesis by attending classes in the departments of Life Science, Chemistry, and Materials Science and Engineering. She also said that some of her students practically lived in the lab, in order to learn the latest research methods in various fields, which they then taught to the rest of the team.

Hung believes that one of the advantages of studying electrical engineering is that it gives you a solid background for doing work in various other fields. Furthermore, she expects that her ongoing cross-disciplinary research will give rise to additional innovations.

VR ANATOMY OFFERED AT THE DEPARTMENT OF MEDICAL SCIENCE

In addition to gaming and films, virtual reality (VR) can also be used to teach human anatomy, and the Department of Medical Science has recently purchased ten VR systems for use in the course of "Human Anatomy: A Virtual Reality Approach" taught for the first time in this spring semester. In such a course, students will use a VR headset and joystick to view the entire human body layer by layer, including various organs that are not readily visible in conventional dissection, such as arteries, veins, and nerves.

Director Chen Linyi of the Department of Medical Science said that her department emphasizes basic science and applied medicine; teaches students how to conduct research on disease pathology and how to develop medical equipment and pharmaceuticals. For example, graduates of the department might work on the development of a blood test for detecting various abnormalities; or they might conduct research on cancer metastasis mechanisms, or on how to promote nerve regeneration after brain injury, or on whether gastrointestinal bacteria cause neurodegenerative diseases. However, a solid understanding of human anatomy is the foundation of all such works, and that's why NTHU has decided to make this substantial investment in VR hardware and software. At present, only a few medical departments in Taiwan have such equipment, and NTHU is the only university without a college of Medicine using VR to teach anatomy.

Prof. Chen also pointed out that due to the relative scarcity of cadavers for dissection, courses in human physiology usually teach anatomy by using books, simple models, and films, none of which are very realistic, especially in terms of three-dimensional space. With the advent of VR, however, anatomy education has been greatly improved.

Shyu Yueh-ming, a senior in the College of Life Science, is very interested in human anatomy. Last year, the Department of Medical Science and the National Defense Medical Center jointly dissected several cadavers, but even though this approach provides the most accurate view, it suffers from various limitations, such as the instability of a dissected brain and the small size and high fragility of the eyeball.

"I'm now studying the eye, the sclera, followed by the cornea, choroid, and the lens," says Shyu while wearing the VR headset and operating the joystick to reveal each element in turn. It's also possible to rotate the view to see the back of the eyeball, and to zoom in to see fine details, neither of which could be done when dissecting a real cadaver.

Sun Zhongyu, a junior in the College of Life Science, said that whereas anatomy textbooks have separate chapters on bones, muscles, and the nervous system, the VR dissection system integrates the various organ systems into a holistic whole, making it easier to see the relative positions of the organs, and to understand how a drug passes into blood vessels and through the blood-brain barrier and into the nervous system.

Lin Hsin-yu, also a junior in the Department, said that as soon as the VR human anatomy system was up and running there was a scramble to give it a try, and that whereas learning anatomy was once a tedious matter of rote memorization, now it's more like playing a video game, adding that the organs and tissues appear highly realistic, and that a few reviews are enough to commit an organ to memory.

The course "Human Anatomy: A Virtual Reality Approach" is being taught by Prof. Lee Jia-Lin of the Department of Medical Science. He said that in addition to asking students to use the VR system to find a designated organ within a certain period of time, he also poses various application questions, such as "If a bullet enters the upper left abdomen, which organs are likely to be injured?"

One of the main limitations of using VR to study anatomy is that it doesn't provide students with a realistic tactile sense, the kind that presently only comes from actually cutting into a muscle or a liver. However, Chen says that she is investigating the possibility of working with other NTHU faculty on developing a VR anatomy system which provides a realistic tactile sense, as well as medical equipment combining VR and physiological testing to help students overcome their fear of human anatomy.

ⓐ Director Chen Linyi (pointing to screen) of the Department of Medical Science showing students how to use the VR anatomy system.

ⓑ Students of the Department of Medical Science using a VR system to study human anatomy.

ⓒ Director Chen Linyi (right) and Associate Professor Lee Jia-Lin of the Department of Medical Science.

ⓓ The VR anatomy system provides detailed views of the entire human body from various angles.

ⓔ Anatomy students wear a VR headset and use the joystick to view the details of the entire human body from various angles.

ROC Army personnel in a live fire exercise. (Courtesy of the Military News Agency.)

NEW OFFICER TRAINING PROGRAM LAUNCHED

In order to cultivate the next generation of military leaders, NTHU and the Ministry of National Defense have recently established the NTHU Cadet Program, which is currently recruiting ten students to the Military Science Group at Tsinghua College for the upcoming school year. Those who are admitted will receive a full scholarship along with a monthly stipend of NT$12,000 and a book allowance of NT$5,000 per semester.

President Hocheng Hong said that military science is an integral part of being a top-notch university, adding that the famous general Sun Li-jen graduated from NTHU a

Navy personnel learning how to operate a drone. (Courtesy of the Military News Agency.)

"Space Force" to its armed forces, which already uses a huge number of military robots. Thus it is essential for the high-ranking officers of the future to be skilled in the use of various types of advanced technology.

Hocheng further indicated that the overall aim of the NTHU Cadet Program is to train students to be equally proficient in military science and a particular academic discipline, adding that students in the program will leave their major undeclared for their first year, and will be required to select a major in their sophomore year.

Prof. Chiao Chuan-chin, who serves as the director of the Student Recruitment Center, said that the new program is unique in that it starts when the student is admitted and continues through all four years of their university education, in contrast to the long-standing Reserve Officers' Training Corps (ROTC), which recruits students who have already been admitted. In addition to the general university admission exam, applicants to the NTHU Cadet Program have to pass the Ministry of National Defense's intelligence test, physical fitness test, and background check.

Chiao said that the program's first batch will consist of ten students (including at least one female recruit), four of whom will be preparing to join the Information and Electronic Warfare Command, with the remaining six evenly distributed between

the Army, Navy, and Air Force; all ten will be eligible to receive aviation training. After graduating, each participant will be required to serve in the military for at least five years as a second lieutenant with a monthly salary of around NT$50,000; those who become qualified pilots will be required to remain on active duty for a longer period of time.

"Compared with other types of military training, the NTHU Cadet Program offers a lot more flexibility," said Chiao, adding that in addition to their regular university studies, recruits will be required to participate in military training every Saturday as well as during winter and summer vacations. Moreover, NTHU's flexible curriculum and wide variety of majors provides an ideal academic environment for meeting the Program's goal of training officers with specialized knowledge in various fields.

Chiao added that the Ministry of National Defense also provides career officers with opportunities to study for graduate degrees, and that those who choose to leave the military after completing their five years of active duty can easily shift to a civilian career; for example, those who have received flight training would be well prepared for a career as a commercial pilot.

ⓐ Calibrating navigational equipment on the open seas. (Courtesy of the Military News Agency.)

ⓑ Captain Gao Ciyu, the first female pilot of the ROC Air Force. (Courtesy of the Military News Agency.)

ⓒ Safely parachuting in difficult terrain requires extensive training. (Courtesy of the Military News Agency.)

CHUN-SHAN CONCERT HALL TO BE ESTABLISHED

On January 4th NTHU announced a plan to convert the Auditorium into a concert hall with international standards and name it as the "Chun-shan Concert Hall" in honor of former president Shen Chun-shan, who passed away last September.

In last December, NTHU held a memorial event in honor of Shen featuring a concert and a chess match, during which his friends and associates proposed converting the Auditorium into the Chun-shan Concert Hall as a concrete way of commemorating a figure who has played such a prominent role in the development of the University. Former NTHU president Liu Chung-laung launched the fund-raising campaign by donating NT$2 million, inspiring numerous alumni and music lovers to follow suit.

Since its completion in 1973, the Auditorium serves as a venue for a wide range of activities, including ceremonies, speeches, and art performances. However, its acoustics, stage design, and seating don't meet concert hall standards.President Hocheng Hong said that after Shen passed away his friends from all walks of life decided to establish a concert hall in Hsinchu bearing Shen's given name.

President Hocheng also said that Shen was both a scientist and a man of letters, and that this was perhaps related to his career in astrophysics, since the movement of celestial bodies is not only the subject of scientific study, but also a source of inspiration for art and culture. Similarly, music is highly structured, yet also appeals to the deepest levels of human emotion. Thus a concert hall named after him seems to be the best way to commemorate Dr.Shen, a true renaissance man.

The renovation plan for the Auditorium includes structural reinforcement and replacing the lights, sound system, stage

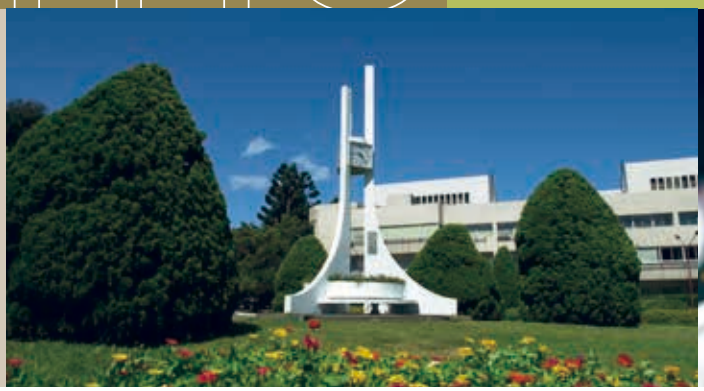
NTHU is currently raising funds for the future Chun-shan Concert Hall.

and seats, and is expected to cost more than NT$160 million. Upon completion, the concert hall will have a seating capacity of 1,300 and will meet the standards required by a full fledged orchestras.

Vice president and chief of staff Lyu Ping-chiang said that the Chun-shan Concert Hall is expected to be on par with the three world-class concert halls currently in use in Taiwan: the National Concert Hall in Taipei, the National Taichung Theater, and the National Kaohsiung Center for the Arts (Weiwuying). Lyu also pointed out that many people at the Hsinchu Science Park are actually music fans, and that Hsinchu has a music radio station "IC FM97.5"which can be expected to promote high-quality local music performances.

Prof. Chang Fang-Yu, the director of the Music Department, added that the new concert hall will be a real boon to her department, the Vocal Performance division of which recently performed an opera in conjunction with the College of Arts and the Department of Foreign Languages.

A poem written by Shen Chun-shan displayed at the memorial event held in his honor.



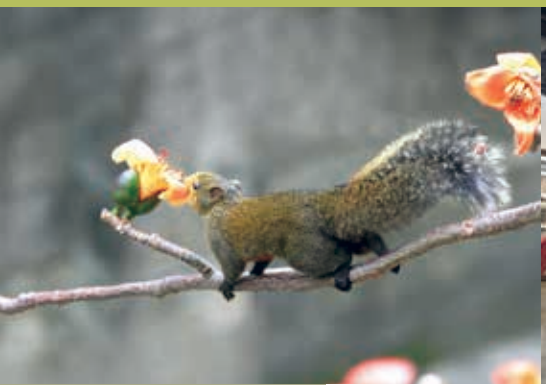
AN EXHIBITION OF UKIYO-E ART

In East Asia early spring is the season for admiring plum and cherry blossoms, and both of these figure prominently in the exhibition of Japanese art titled "Panorama of a Flourishing World: Ukiyo-e from the NMH Collection" currently being held at NTHU. The 46 prints and paintings in the exhibition are in the ukiyo-e (floating world) style popular in Japan during the Edo period (1603–1867) and feature various scenes of ordinary people engaged in such activities as viewing flowers and watching a performance.

Jointly organized by the NTHU Museum Preparatory Office and the National Museum of History (NMH), the exhibition is being held on the first floor of the Macronix Building, and will continue to the end of March; admission is free.

NMH director Liao Hsin-tien said that the Museum's collection of about one hundred ukiyo-e prints was donated in 1998 by a Japanese collector keen on making these unique works of art more widely available to the public. The bulk of the artwork currently held by the NTHU Museum Preparatory Office was

Painting by Utagawa Yoshiiku in the exhibition "Panorama of a Flourishing World: Ukiyo-e from the NMH Collection." (Photo courtesy of NHM.)



donated by Professor Yang Rur-bin of the Department of Chinese Literature, much of which was exhibited at the NMH in 2009.

Liao said that the term "ukiyo-e" originated from the Buddhist doctrine on the ephemeral and illusory nature of the phenomenal world. Over the course of its long development, ukiyo-e came to be noted for its exquisite depictions of folk life, with a delicate style giving vigorous expression to the lifestyle and aesthetics of the common people. "Ukiyo-e takes us back in time and shows us how Japanese people appreciated cherry blossoms a hundred years ago—an activity modern people easily relate to," explained Liao.

NTHU Museum Preparatory Office director Ma Mengjing pointed out that most of the paintings in this exhibition were produced by artists belonging to the Utagawa school—the largest school of painting in the Edo period—including Utagawa Kunisada and Utagawa Yoshiiku. The exhibition is divided into four themes: "Feminine Beauty" depicting both geishas and working class women; "Performers" depicting scenes from the kabuki theater; "In Vogue" consisting of illustrations from popular novels; and "Landscapes" depicting famous tourist sites.

At the entrance to the exhibition space are two pictures of plum blossoms. Although these two works were made by different artists, the composition is similar; in the foreground we use a handsome man and a lovely woman dressed in gorgeous robes, while in the background are plum blossoms reflected in the water. In addition to the details of the costumes and hairstyles, such details as the stone lanterns and tea set are

ⓐ The 46 works in the exhibition depict people engaged in such activities as viewing flowers and watching a performance.

ⓑ Visitors are invited to make their own ukiyo-e postcard print by using rubber stamps provided at the exhibition.

ⓒ NTHU Museum Preparatory Office director Ma Mengjing at the opening of "Panorama of a Flourishing World."

also clearly depicted.

Ma pointed out that both of these works illustrate the costumes and hairstyles that were in vogue amongst the nobility of the time, and that upon noticing the woman with her elbows resting on the ground in the lower left of one of the pictures, viewers may well wonder if she is admiring the plum blossoms or the handsome man standing nearby.

Ma has just returned from a trip to Hiroshima, Japan, where the plum blossoms were already in full bloom, at about the same time when Taiwan was entering the cherry blossom season—both of which feature prominently in this exhibition.

Ma said that many of the works on display were done by Utagawa Kunisada (1786–1865), widely regarded as the most famous and prolific ukiyo-e artist of his generation, and whose work was widely reproduced in the fashion magazines of the time.

Ma also noted that some of Kunisada's works caused quite an uproar when they first came out, especially those depicting controversial incidents.

In addition to his prints, Utagawa Yoshiiku also provided illustrations of current events for the Tokyo Daily News, such as the Mudan Incident, an 1874 Japanese punitive expedition against the aboriginal tribes in southern Taiwan. Ma said that the ukiyo-e paintings in this collection on the theme of war will be displayed in a separate exhibition in late April.

At the entrance to the exhibition is a miniature Japanese garden with a plum tree, stone lanterns, and white stones, which makes a great background for a souvenir photo.

In addition to receiving a limited edition guidebook, visitors have the unique opportunity to make their own ukiyo-e postcard print by using rubber stamps provided at the exhibition.

ⓐ Admiring spring blossoms is a time-honored tradition throughout East Asia.

ⓑ At the entrance to the exhibition is a miniature Japanese garden with a plum tree, stone lanterns, and white stones—a fine background for a souvenir photo.

DEPARTMENT OF PHYSICAL EDUCATION RENAMED AS THE DEPARTMENT OF SPORTS SCIENCE

On February 13th NTHU announced that the Department of Physical Education will be renamed as the Department of Sports Science, and next year will begin recruiting two groups of students : the Althletic Competition Group and the Sports Science Group. Those intending to join the Sports Science Group can apply on an individual basis by submitting the results of the university entrance exams in particular subjects, and won't be required to take an athletics ability test. The Sports Science Group is intended for those with a strong interest in such areas as artificial intelligence (AI), human factors engineering, neuroscience, materials development, and sports management.

The Athletics Competition Group is intended for promising athletes and will focus on performance and coaching. Amongst those planning to apply to this group are the star archers Tan Ya-ting and Lin Shih-chia.

President Hocheng said that the field of sports science draws on the insights and researches of physiology, psychology, management, electronics, mechanics, materials, and even aesthetics, and that its range of application is continually expanding. President Hocheng further indicated that NTHU has a long tradition of athletic excellence, and is now planning to give increased attention to the integration of sports and technology.

Multiple admission channels

The Department of Physical Education was added to NTHU as a result of the merger with National Hsinchu University of Education (NHCUE). The director of the Department of

a President Hocheng said that NTHU is planning to give increased attention to sports technology.

Sports Science will be Professor Chiu Wen-hsin, who is currently the director of the Department of Physical Education. Chiu said that the global sports industry is growing rapidly, and that in the United States the sports industry is several times bigger than the automobile and film industries. He also said that there is a growing need for education and research in sports science, as can be seen in the recent establishment of departments of sports science at such top universities as Nanyang Technological University in Singapore and Waseda University in Japan.

High school students who are interested in applying to the Sports Science Group for the 2019 school year can submit an individual application to the Department. This is the first time that the Department will be accepting applications without the standard performance exam.

Director Chiu also said that the students in the Althletic Competition Group and the Science Group will be required to work together on an eight-credit graduation project, which might focus on such topics as athletic training, sports equipment development, or performance analysis. Chiu said that graduates of the Department will be qualified for such work as managing sports venues, designing new sports venues, developing sports equipment.

Enhancing performance with technology

Chiu said that a number of the courses for the Science Group will be taught by NTHU faculty specializing in life sciences, electrical engineering, and computer science, and that the Department will work closely with the Sports Technology Center established at the end of last year. Courses offered by the Department include sports management, sports biomechanics, and sports psychology, and students in the program are also required to take courses in life sciences, electrical engineering, and computer science.

One of the Department's faculty members is Professor Ma Hsi-pin, who also teaches in the Department of Electrical Engineering. A research team led by Ma has developed a pitcher training system using sensors and pressure gauges embedded inside a baseball to measure the trajectory and rotational speed of pitches, as well as the strength of the pitcher's fingers, helping the pitcher to adjust the force and angle applied when using various pitching techniques. Professor Ma is also planning to develop a kind of biosensor IC technology for instantly measuring such physiological functions

as heartbeat and breathing, which can be used by a baseball player to assess his psychological state, concentration level, etc.

Also teaching in the Department of Sports Science is Prof. Lee Yun-ju, who also has a joint appointment in the Department of Industrial Engineering and Engineering Management. She specializes in biomechanics and human factors engineering, and in her work at the Sports Technology Center she has developed a system for improving batting technique by monitoring the batter's center of gravity and angle of vision by using ground force plates and eye trackers.

Training world-class athletes

Director Chiu said that students in the Althletic Competition Group will be admitted based primarily on their athletic skill, and will be encouraged to gain some degree of expertise in one or more areas of sports science, such as human factors engineering, biomedical science, sports equipment, or information technology.

Amongst the star athletes already appointed to teach in the department are baseball player Lin Kun-han and badminton player Hsu Jen-hao, and additional appointments will be made in accordance with the students' specialties.

Hsu compared the training methods typically used by athletes in the past to the backyard smelting furnaces used in China during the Great Leap Forward, and said that today's training regimens are very high-tech.

Amongst those planning to apply to the Competition Group are award-winning archers Tan Ya-ting and Lin Shih-chia, both of whom were encouraged to apply by their coach, Ni Dazhi. Both Tan and Lin already have master's degrees related to sports science, but are convinced that joining NTHU's program will both enhance their performance and open up future career possibilities.

ⓐ Amongst the star athletes appointed to teach in the Department of Sports Science is baseball player Lin Kun-han.

ⓑ Badminton champion Hsu Jen-hao will also be teaching in the Department of Sports Science.

NTHU

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
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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

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