

# NSYSU RESEARCH Highlights



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*National  
Sun Yat-sen  
University:*

*An*

**AI<sup>2</sup>**

*University*

**National Sun Yat-sen University** (NSYSU), founded in 1980, is one of Taiwan's top research universities, with ten colleges and over 10,000 students. Located in Kaohsiung, it benefits from strong industry ties with partners like TSMC and ASE Group.

NSYSU excels in research areas such as ocean acidification, underwater vehicles, 6G MIMO systems, silicon photonics, intelligent e-commerce, and international sinology, and hosts Asia's only Aerosol Science Research Center. In 2022, it established a College of Medicine to improve regional healthcare.

Under President Chih-Peng Li since 2024, NSYSU is shaping its future as an “**AI<sup>2</sup>**” university

—**Artistic & Inclusive,  
Advanced & Innovative.**







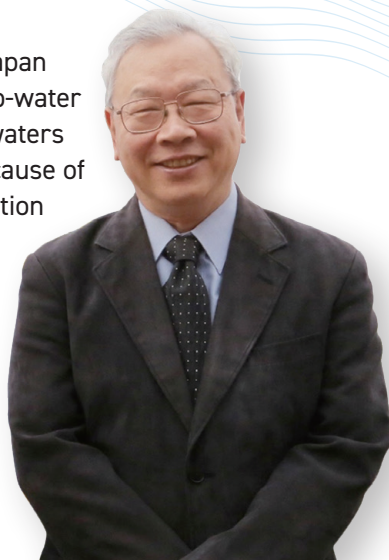
# MARINE SCIENCES

## Deep Waters, Global Impact: Dr. Arthur Chen's Ocean Science

Dr. Chen-Tung Arthur Chen is a leading researcher on the global carbon cycle and ocean acidification. His research has taken him to remote regions and led to significant international roles, including seven years as Senior Vice Chairman of the International Geosphere-Biosphere Program under ICSU (International Council for Science). He has published influential first-authored papers in *Nature* and *Science* on ocean carbonate chemistry and developed a method to calculate fossil fuel-derived CO<sub>2</sub> in the oceans, helping clarify its role in acidification.

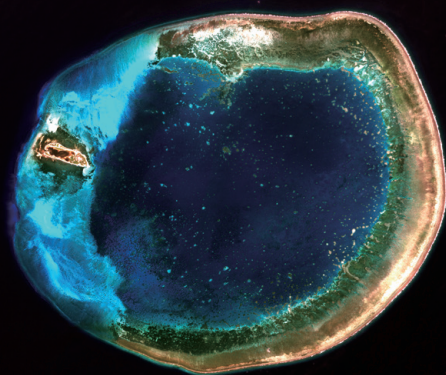
Dr. Chen was the first to predict that the Sea of Japan could become anoxic by 2200 due to reduced deep-water circulation. He also highlighted that deep ocean waters may acidify faster than previously anticipated because of warming-induced stagnation. To examine acidification impacts, he initiated studies at hydrothermal vents off Taiwan's Gueishan Island, discovering the lowest pH ever recorded in global waters.

In recognition of his impact, a 2024 Stanford University study ranked him No. 5 among 16,080 oceanographers worldwide. That same year, he was elected as an Academician of Academia Sinica, Taiwan's top academic honor.

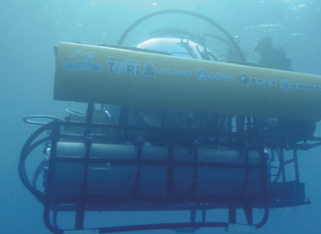


## Dongsha Atoll Research Station: Advancing Marine Science and Climate Research

Established in 2012 by National Sun Yat-sen University with support from the National Science and Technology Council, the Dongsha Atoll Research Station (DARS) promotes marine



## NSYSU Launches Taiwan's First Manned Research Submersible



The Underwater Vehicle R&D Center (UVRC) at National Sun Yat-sen University (NSYSU) has developed Taiwan's first manned research submersible, leveraging NSYSU's expertise in unmanned vehicle technology and support from academic and industry partners. The submersible includes a manned spherical cabin with air conditioning and life support, dual power systems, integrated thrusters with a control system, and a buoyancy and ballasting system.

A major milestone was achieved when the submersible successfully completed manual navigation off Liuqiu Island, carrying two crew members. This breakthrough marks a significant step in advancing Taiwan's subsea research capabilities.

UVRC plans to enhance the submersible's performance by increasing its maximum diving depth and improving onboard functionality and comfort. The Center will continue to collaborate with government, industry, and academia to strengthen Taiwan's subsea technology and promote the development of a domestic marine industry supply chain.

research in the remote Dongsha Atoll. Home to Taiwan's largest seagrass beds and shaped by nutrient-rich internal waves, the atoll supports a rich coral reef ecosystem and high biodiversity, making it a key blue carbon sink. DARS conducts long-term monitoring of ocean conditions—such as water temperature, dissolved oxygen, chlorophyll, and nutrients—in the South China Sea. It plays a pivotal role in connecting global researchers, fostering biodiversity studies, ecological monitoring, and climate-related science. Beyond advancing scientific knowledge, DARS supports international collaboration and nurtures future scientists. Through its efforts, DARS strengthens Taiwan's visibility in global marine science and contributes meaningfully to tackling climate change.





# ENGINEERING

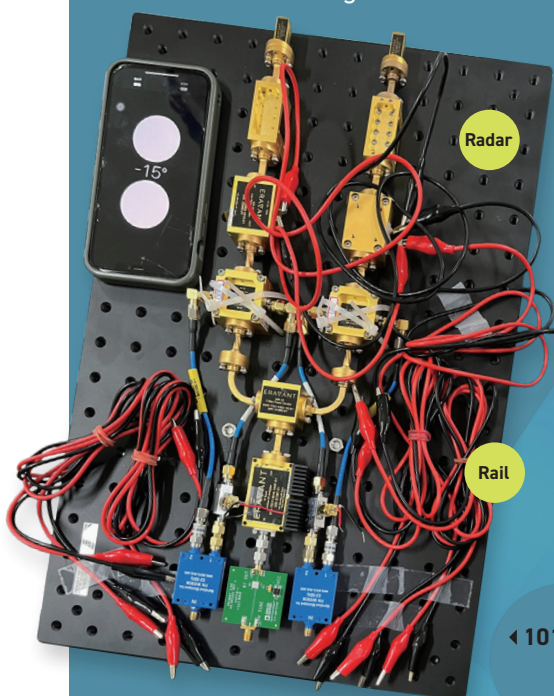
## Advancing 6G Boundaries: MIMO Innovation from Taiwan

The Sixth Generation Communications and Sensing Research Center, led by Lifetime Honorary National Chair Professor Kin-Lu Wong and funded by Taiwan's Higher Education SPROUT Project, is advancing 6G innovation through two research groups. The High Order MIMO Communications System group focuses on antenna design and baseband algorithms, recently achieving 25–31 bps/Hz spectral efficiency in a 7.1 GHz field trial using smartphones—over four times that of standard 5G—highlighting strong potential for upper mid-band 6G.

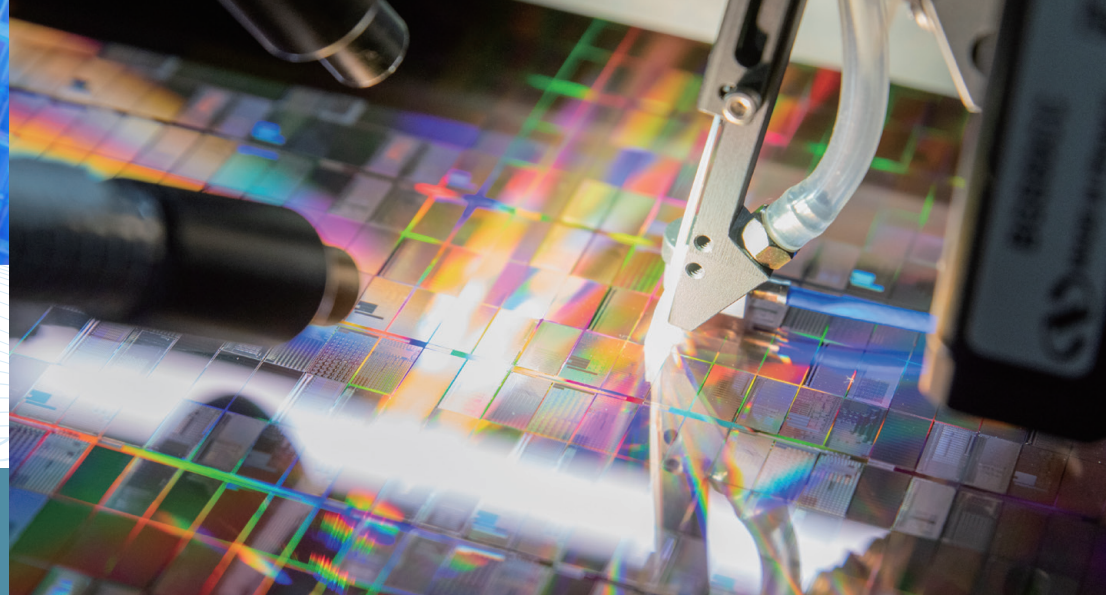
The High Frequency MIMO Sensing System group has introduced a novel radar system that combines synthetic aperture radar with super-resolution algorithms. Live demonstrations showcased real-

time physiological sensing and multi-target tracking with high precision, drawing significant industry and media attention.

With a citation rate nearly twice the global average, the Center's global influence continues to grow through collaborations with the University of Southampton, University of Southern Denmark, Penn State University, and the EU's 6G SANDBOX initiative.



101 GHz SIL SAR



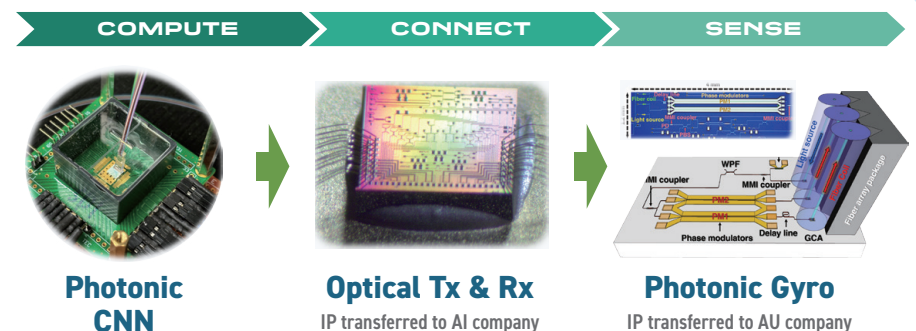
## NSYSU Advances Silicon Photonics for Navigation and AI Applications

Led by Professor Yung-Jr Hung, NSYSU researchers are pioneering silicon photonics through global collaborations, securing over NT\$100 million in funding. Their innovations target communication, high-performance computing, and sensing.

A standout breakthrough is a silicon photonic integrated circuit and fiber optic gyroscope that shrinks the size and cost of traditional photonic gyroscopes to 10%, while offering over ten times the precision of MEMS-based systems. Ideal for satellites, drones, autonomous vehicles, and

robotics, the technology was transferred to Australian firm Azimuth Avionics and earned a Gold Medal at the 2025 National Invention and Creation Awards.

Another key advancement is a silicon-based wavelength division multiplexer and demultiplexer, enabling high-speed data transmission for AI data centers. This technology, transferred to BE Epitaxy Semiconductor, is now part of a partnership with AMD to develop silicon photonics optical engines for optical I/O applications, marking a critical step toward real-world deployment.





## Green Biotechnologies for CO<sub>2</sub> and CH<sub>4</sub> Removal and Valorization

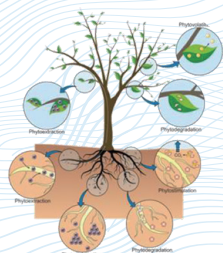
Carbon dioxide (CO<sub>2</sub>) and methane (CH<sub>4</sub>) are the two most impactful greenhouse gases driving climate change. In line with environmentally sustainable governance, the research team led by Chair Professor Chih-Ming Kao has developed green technologies to remove and valorize both naturally occurring and human-induced CO<sub>2</sub> and CH<sub>4</sub> emissions.

Using nature-based solutions, CO<sub>2</sub> and CH<sub>4</sub> are biologically decomposed by *Xanthobacter autotrophicus* and *Methylobacter* sp. NSYSU, respectively. These processes convert greenhouse gases into reusable alcohols and biomass, promoting green sustainability and advancing net-zero goals.

To address any CO<sub>2</sub> released during decomposition, the team also developed CO<sub>2</sub> absorbents made from biochar, waste gypsum, and basic oxygen furnace slag. These absorbents not only capture CO<sub>2</sub> efficiently but can also be reused as subgrade materials, enhancing soil carbon sinks while supporting carbon sequestration.

This integrated approach offers a practical and sustainable pathway to mitigate greenhouse gas emissions while creating value-added byproducts.

◀ Application of immobilized strains of CO<sub>2</sub>-utilizing and CH<sub>4</sub>-oxidizing bacteria for greenhouse gas emission control at a soil remediation site.



## Pioneering Fluid Technology Puts Taiwan on the Global Semiconductor Map

Professor Ting-Chang Chang's innovative supercritical low-temperature fluid defect passivation technology has significantly enhanced the performance and reliability of semiconductor devices. Backed by Taiwan's Ministry of Science and Technology (MOST) through its Value Creation Program in 2019, this breakthrough attracted investment from Taiwan's AUO Corporation and Japan's Tokyo Electron Limited (TEL), leading to the establishment of the startup Naidun-tech.

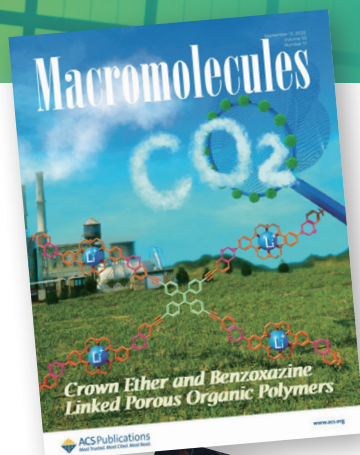
Recognized as a transformative technology for the semiconductor industry, the technology was featured by NSTC in 2022 at a press conference

## Advancing Polymer Science for a Sustainable Future

Professor Shaio-Wei Kuo's research began with a focus on hydrogen bonding between polymer chains to understand how molecular interactions shape material properties. This work has since expanded into polymer self-assembly, mesoporous materials, and porous organic frameworks such as CMPs and COFs, alongside studies on polymer nanocomposites, CO<sub>2</sub>-based polymers, and novel low-surface-energy thermosetting systems.

Recognized as Taiwan's top polymer scientist and ranked among the world's top 2% in the field, Professor Kuo leads a team known for strong international collaborations and high-impact research, with several publications featured on journal covers. Their innovations address global challenges in sustainable energy storage, environmental remediation, carbon neutrality, and next-generation semiconductors.

By integrating fundamental chemistry with advanced material design, the team develops practical and eco-friendly solutions for industry and society. With an average journal impact factor of 6.75, their multidisciplinary research not only advances academic frontiers but also trains future leaders in polymer science.



*"Breakthrough in Scientific Research and Innovation—Let the World See Taiwan."*

In a landmark achievement, TEL successfully acquired Naidun-tech in June 2024—marking the first time a technology fostered under the NSTC's Value Creation Program has been acquired by a major international corporation. This milestone underscores Taiwan's growing influence and leadership in global semiconductor innovation.

Before Treatment



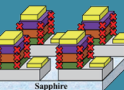
After Treatment



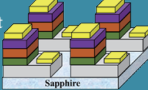
Traditional LED



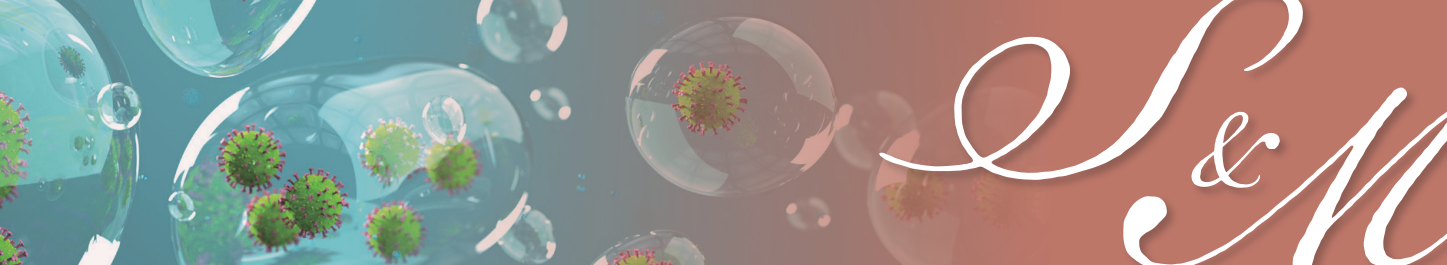
Micro LED



After Treatment





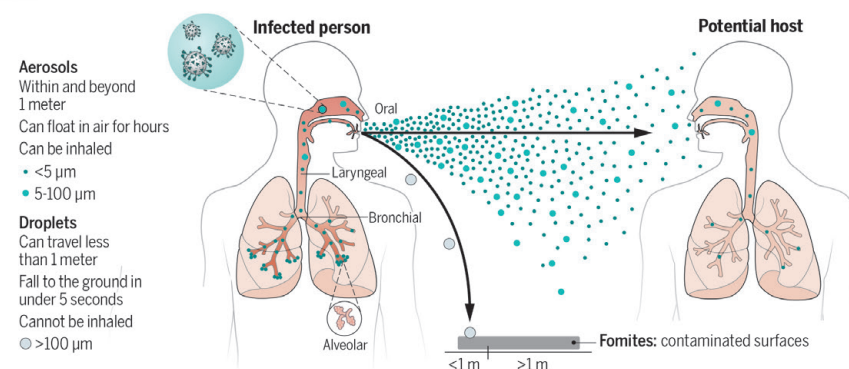
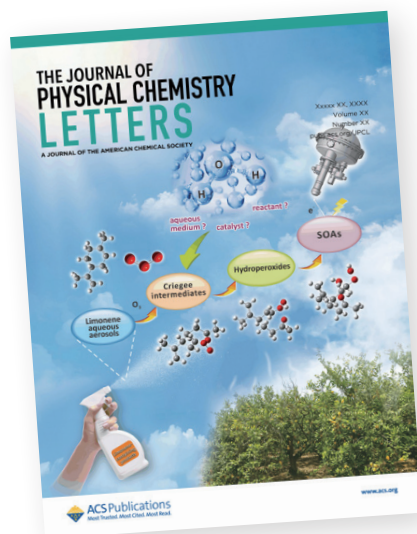


# SCIENCE & MEDICINE

## The Rise of Aerosol Research in Taiwan and Asia

Dr. Chia-Chen Wang, a pioneering physical chemist, has significantly advanced aerosol science in Taiwan and Asia. In 2017, she founded the Aerosol Science Research Center (ASRC) at National Sun Yat-sen University—the first of its kind in Asia—as a hub for interdisciplinary research. She developed the first high-resolution aerosol VUV photoelectron spectroscopy technique, revealing how pH affects the redox behavior and interfacial properties of aqueous aerosols, and uncovered water's role in secondary organic aerosol formation.

During the COVID-19 pandemic, Dr. Wang helped shift global health policies by highlighting airborne transmission, with two influential *Science* publications. She also created *The Quest of Virosols*, a multilingual educational comic. ASRC promotes public engagement through its AeroMUSIC co-Learning program and advances aerosol-based therapies. Recognized in 2023 as a Featured Areas Research Center under Taiwan's Higher Education Sprout Project, ASRC reflects Dr. Wang's commitment to connecting science with urgent global challenges.

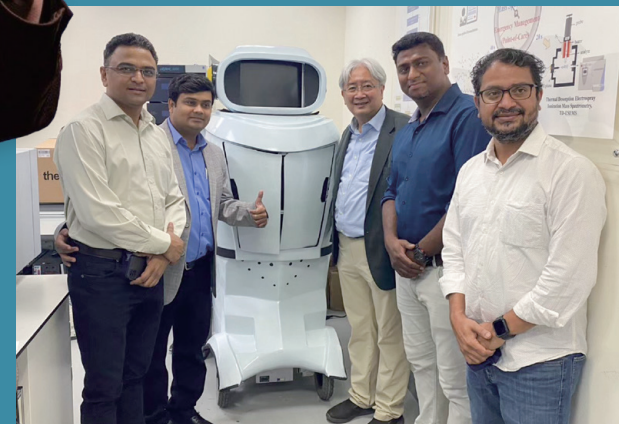


## Pioneering Innovations in Ambient Mass Spectrometry

Dr. Jentaie Shiea, chair professor of Chemistry and director of the RSCTB, is a global pioneer in ambient mass spectrometry. He received Outstanding Research Awards from the National Science and Technology Council in 2009 and 2019. Dr. Shiea co-founded the Taiwan Society for Mass Spectrometry (2003) and the Asia and Oceania Mass Spectrometry Conference (2012). A former fellow of the Royal Society of Chemistry, he served seven years as Asia and Oceania Regional Representative on the executive board of the International Mass Spectrometry Foundation.

His research spans analytical chemistry, instrumentation, material sciences, and biomedicine. Dr. Shiea has advanced portable ambient mass spectrometric techniques for on-site detection of toxins, drugs, explosives, and pollutants—supporting food safety, law enforcement, counter-terrorism, environmental monitoring, and emergency medicine.

He also developed interfaces to integrate mass spectrometry with chromatographic systems, enhancing compound identification and separation. Additionally, his application of mass spectrometry in clinical medicine has significantly improved diagnostic efficiency.





## Oral-Brain Axis Innovation: AI, Biofeedback, and Big Data Transform Sleep and Oral Health

Prof. Yen-Chin Chen is advancing tech-driven care to help older adults sleep better, breathe easier, and stay healthier. Her lab integrates big-data epidemiology, user-focused clinical trials, smart-device design, and evidence-based nursing. NSTC-funded projects enhance CPAP therapy for obstructive sleep apnea (OSA) with AI-based mask fitting and AR guidance, improving comfort and long-term use.

Meanwhile, cohort studies show that brief behavioral therapy, biofeedback, and oral-frailty care significantly boost sleep quality and reduce aspiration pneumonia risk in frail patients.

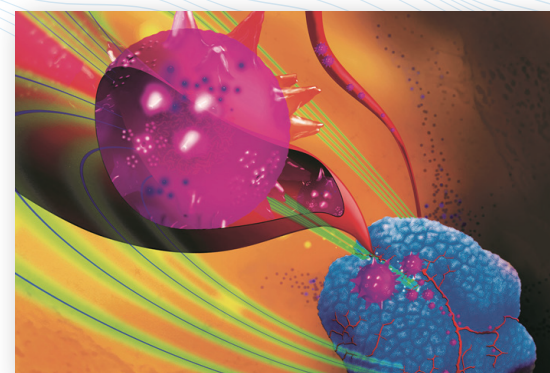
Now, Prof. Chen's team is co-developing an AIoT early-warning system that combines eye-movement signals, oral-brain microbiome data, muscle strength, and sleep patterns to deliver personalized, preemptive care—before cognitive or functional decline sets in.

With over 50 peer-reviewed papers—including a highly cited study in *Geriatrics & Gerontology International*—and numerous innovation awards, Prof. Chen leads pioneering, nurse-led research at the intersection of oral and sleep health for aging populations.

## Advancing Cancer Treatment through Nanotechnology and Virology

Dr. Zi-Xian Liao, recipient of the 2023 Ta-You Wu Memorial Award, leads a research team at the intersection of biotechnology, nanomaterials science, and virology, aiming to revolutionize cancer treatment. By leveraging

nanotechnology, the team enhances immunotherapy and viral delivery systems, and develops innovative, light-activated, tumor microenvironment-responsive nanoparticles that specifically target clinically drug-resistant cancers. Their work has been published in SCI-indexed journals, and their



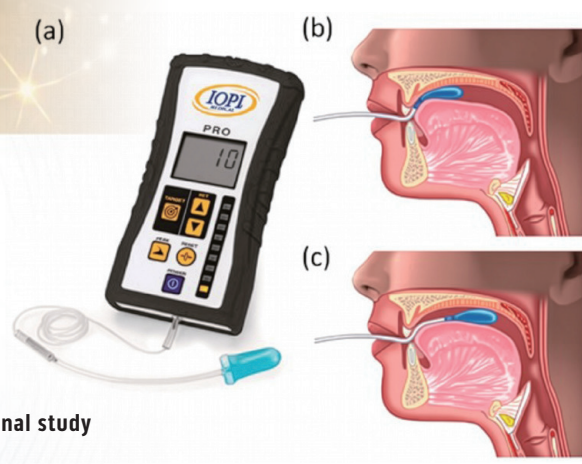
nano-engineered virus technologies are patented in Taiwan, Japan, and China. Looking ahead, this nano-modified virus platform holds great promise for transforming the treatment of various genetic diseases by improving the efficacy of existing therapies and significantly expanding the clinical applications of viral systems—paving the way for future clinical adoption.

## WILEY Top Cited Article

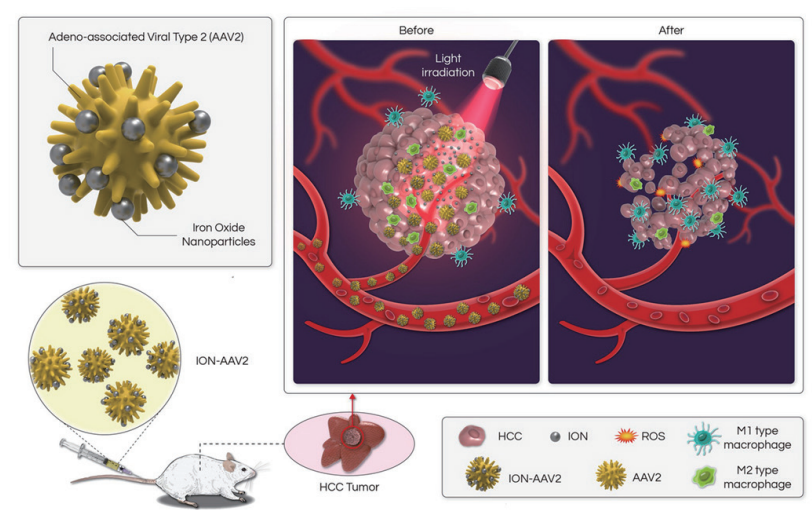
Congratulations to:  
**Yen-Chin Chen**

Whose work has been recognized as a top cited article\* in:  
*Geriatrics & Gerontology International*

**Tongue pressure during swallowing  
is an independent risk factor for  
aspiration pneumonia in middle-aged and  
older hospitalized patients: An observational study**



\*Among work published between January 1, 2023 and December 31, 2023.





## Just Transition Research

Professors Mei-Hua Chen and Hong-Zen Wang lead a multidisciplinary research team advancing **Just Transition**—a framework that ensures the shift to net-zero emissions protects the rights of vulnerable groups. Their work explores the social impacts of green transportation, renewable energy, and Indigenous rights through case studies on civic dialogue, social impact assessment, and education.

The sociology team has studied the mobility challenges of migrant women in Kaohsiung, highlighting the intersections of gender, migration, and access to green transport. These findings have informed efforts to promote inclusive urban mobility and public dialogue.

The education team has developed Just Transition curricula for primary and secondary schools, integrating sustainability and equity into classroom teaching and teacher training.

Siwan College contributes through action research on swidden agriculture, collaborating with Indigenous communities to preserve traditional knowledge and cultural practices.



## Engaging the World Through Sinology, Building Pathways to Global Co-Becoming

The Global Co-Becoming and International Sinology Research Center (GCIS) draws on the Sinitic-world's rich humanistic tradition to advance philosophies of co-becoming. From 2021 to 2024, GCIS hosted numerous lectures, conferences, and workshops in collaboration with institutions such as Harvard University, the University of Tokyo, National Central Library, National Tsing Hua University, NYU, and others. Scholars from over ten countries—including the U.S., Canada, the U.K., France, Japan, and Taiwan—have participated.

GCIS has also launched key publishing efforts to promote “co-becoming” as both a philosophical and social concept. Notable events include the international conferences **Tianxia Order and Philosophies of Co-Becoming** (Sep. 2024, with the University of Tokyo) and **A Cosmos of Vital Feeling** (Apr. 2024, with Harvard University), as well as the **Co-Becoming and the Sino-Island** forum and the **Global Sinologists Interview Series** with the National Central Library.



## Sustainable Intelligent Electronic Commerce Research Center

Led by Professor Chao-Min Chiu of Information Management, the Sustainable Intelligent Electronic Commerce Research Center at NSYSU is a leader in e-commerce research. Based on publications in two top journals—**International Journal of Electronic Commerce** (IJEC) and **Electronic Commerce Research and Applications** (ECRA)—the center ranks first in Taiwan and fifth globally from 2006 to present. In the past three years, the team has published six papers in FT50 journals. In the 2024 global top 2% scientist ranking, five center members were recognized, with Dr. Chiu ranked first nationwide in information systems.

The center fosters knowledge exchange, interdisciplinary collaboration, and global academic partnerships by regularly organizing academic conferences. It also leads initiatives to promote digital equity, such as VR-supported metaverse learning camps in rural schools. These programs enhance student engagement and help bridge the urban-rural digital divide by providing equitable access to advanced educational technologies.



## The Center for Strategy and Human Capital Research

The Center for Strategy and Human Capital Research, led by Professor Shyh-Jer Chen, unites the university's top scholars in innovation, entrepreneurship, HR, family business, and AI data analytics. Focusing on innovation strategy, family business governance, and strategic HR, the center leads cutting-edge research in human capital.

To support academia and industry, it is developing an “Industry and Corporate Talent Database” with key insights into startups, family firms, and ESG trends.

Committed to global talent cultivation, the center recruits postdocs, supports PhD students, and hosts leading international scholars, building strong partnerships with institutes in Europe, Japan, and the U.S., including benchmarking against Cornell's CAHRS.

Through industry collaboration, it advances sustainability and aligns with UN SDGs 8, 9, and 17. The center plays a key role in shaping the future of human capital, innovation, and global engagement.

