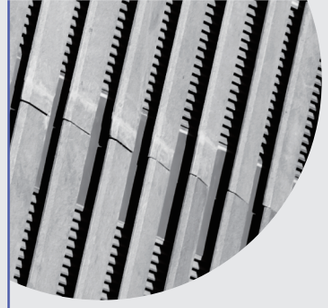

2022

2023

National Tsing Hua University

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NATURE AND LIFE SCIENCE

ENGINEERING

BIOMEDICAL TECHNOLOGY

MATERIALS SCIENCE

HUMANITIES AND SOCIAL SCIENCES

2022/2023
NATIONAL TSING HUA UNIVERSITY
R&D REPORT

About NTHU

National Tsing Hua University (NTHU) has a long and proud history. First established as the Tsing Hua Academy at Tsing Hua Garden in Beijing in 1911, the Academy was renamed as National Tsing Hua University in 1928 as its curricula expanded to that of comprehensive university.

In 1956, NTHU was reinstalled on its current campus in Hsinchu, Taiwan. Since its reinstallation, NTHU has developed from an institute focusing on nuclear science and technology to that of a comprehensive research university offering degree programs ranging from baccalaureate to doctorate in science, technology, engineering, humanities and social sciences as well as management.

NTHU has been consistently ranked as one of the premier universities in Taiwan and is widely recognized as the best incubator for future leaders in industries as well as academics. Such stellar records are particularly exemplified by the outstanding achievements of our alumni, including two Nobel laureates in physics Drs. Cheng-Ning Yang and Tsung-Dao Lee, one Nobel laureate in chemistry Dr. Yuan-Tseh Lee and one Wolf Prize winner in mathematics Dr. Shiing-Shen Chern. On the first of November 2016, NTHU formally incorporated the National Hsinchu University of Education. This merger further diversifies and expands its curricula include arts and education to better prepare our students to take on the challenge of a changing world.

Message from the President

President
Dr. W. John Kao

National Tsing Hua University Hsinchu, Taiwan
November 2023

National Tsing Hua University (NTHU) is a research-intensive university with a long and proud tradition. Since the reestablishment in Hsinchu in 1956, NTHU is known for academic excellence, stellar research output as well as outstanding alumni. NTHU 's core values are shared governance, academic freedom and inclusivity- equality-diversity. NTHU values academic freedom and provides a diverse environment within which our faculty can offer quality teaching and conduct innovative research.

Regarded as one of the top tier research universities, our research activities emphasize fundamental discoveries at the forefront of basic sciences and exploration of breakthrough technologies with high impact. These are reflected in our publications in preeminent journals, international patents received, and technology transferred. In the 2022-2023 R&D annual report, we highlight several important breakthroughs in five fields and also provide the facts and figures related to other important R&D activities.

This volume provides a glimpse into our recent achievements. Hopefully, this can serve as a catalyst for further interactions, exchange of ideas, and establishment of collaborations.We believe that everyone deserves an opportunity to explore and to realize their unique potential. NTHU will uphold our core values—inclusivity, equality, and diversity in everything we do. We will diligently safeguard academic freedom and shared governance as an integral part of our social responsibility and sustainable development.

R&D Facts and Figures

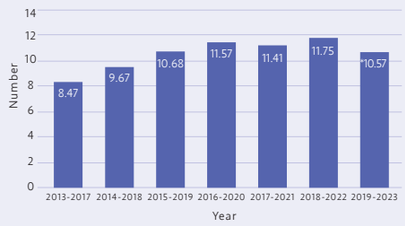
2022 World Rankings

Rankings	Rank
QS Asia University Rankings	34
THE Emerging Economies University Rankings	36
THE Asia University Rankings	59
THE Impact Rankings	201–300

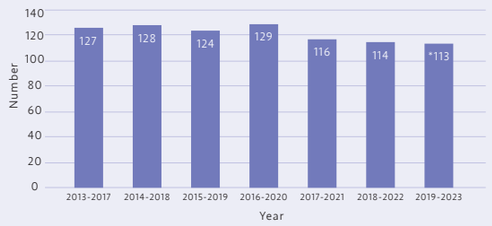
2023 QS World University Rankings by Subject

Top 50-100	Top 100-150
Linguistics (77)	Materials Sciences (105)
Statistics & Operational Research (89)	Electrical & Electronic Engineering (106)
Physics & Astronomy (99)	Chemical Engineering (131)
	Mechanical (133)
	Computer Science & Information Systems (145)

Citations Per Paper



Highly Cited Papers



note1. *Last updated November 10, 2023
note2. Data covers a 10-year and 8-month period: January 1, 2013 -August 31, 2023

2022 Highly Cited Researchers:

Professor. Horng-Tay Jeng (Department of Physics)

2022 Ranking of U.S. Patents

	2016	2017	2018	2019	2020	2021	2022
World Ranking	25	23	24	31	38	46	46
Taiwan Ranking	1	1	1	1	1	1	2

International Patent Application and Registration (2016-2022)

Incubation Programme Glow fast,Glow global

Startups Admitted in 2023	Entrepreneurship by Professors and Students in 2023	Faculty and Student Entrepreneurship Ratio in 2023	2017-2023 Number of Derived Startups (Excluding Departed)
55	40	93%	9

Derived Startups		
	Materials Industry	High Entropy Materials, Inc.
	Biomedical Industry	Enosim Bio-tech Co., Ltd.
		BioPro Scientific Co., Ltd.
		JelloX Biotech Inc.
		Praexisio Taiwan Inc.
		CellEnvision Company Limited
	Software Services Industry	Aydon International Inc.
	Precision Machinery and Instruments Industry	Lei & So Co., Ltd.
		STARX Co., Ltd.

03

Biomedical Technology

Wireless charging-mediated angiogenesis and nerve repair by adaptable microporous hydrogels

Tumor Stroma-targeted Nitric Oxide Nanogel For Cancer Therapy

Vinculin Phosphorylation Impairs Vascular Endothelial Junctions Promoting Atherosclerosis

Wireless charging-mediated angiogenesis and nerve repair by adaptable microporous hydrogels

Professor Shang-Hsiu Hu
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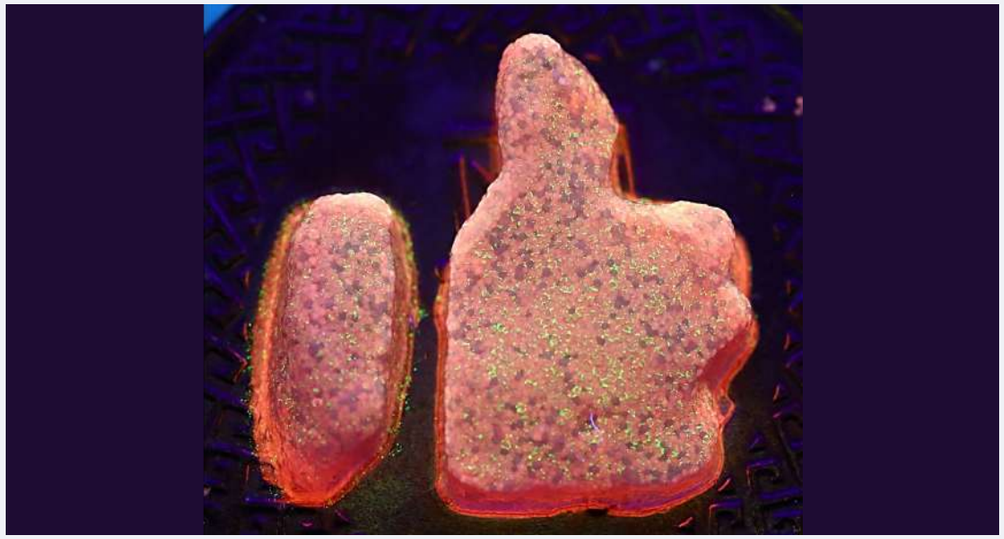

Wireless charging-mediated angiogenesis and nerve repair by adaptable microporous hydrogels from conductive building blocks

Repairing damage to the brain and spinal cord may be medical science's most daunting challenge. Survivors of traumatic brain injury (TBI) may find themselves wondering, can the brain repair? And the possibility is yes. The brain tissue is incredibly resilient and possesses the ability to repair through the process of angiogenesis, neurogenesis. Prof. Shang-Hsiu Hu and his team at National Tsing Hua University displayed a new class of hydrogel-assisted neuroregeneration approaches towards brain injury therapy.At a cost of $400 billion worldwide, an estimated 50 million people suffer from TBI due to the chronic dysfunctions of mood and permeant disability. Clinical trials in TBI to date have not specifically treatments at cerebral atrophy and lack of an effective medical therapy that promotes long-term recovery.

The critical reason for these consequences is that brain damage commonly results in extensive tissue loss and the barrier to tissue regeneration following injury to the central nervous system. However, a long-lasting repair response occurs angiogenesis and neurogenesis into the damaged tissue in the brain is problematic. Following trauma cavity, no extracellular matrix supports cell infiltration into the lesion or physically supports a growing tissue. A large influx of microglia, macrophages and the activation of highly reactive astrocytes, which release pro-inflammatory response and lead to further glial scarring and neuronal death in the peri-trauma area which results in cerebral atrophy (brain shrinkage) occurring in the motor/sensory cortex. These inflammation and glial scarring that impede brain tissue repair, so stimulating angiogenesis and recovery of brain function remain challenging. Currently, hydrogels for brain repair after trauma injury is an emerging treatment option.

Endogenous signals, such as nitric oxide (NO) and electrons, induce multifaceted physiological functions in the regulation of cell fate as well as vascular and neuronal systems. However, clinical difficulties exist due to the short half-life of NO and the lack of tools to spatiotemporally drive gas release and electrical stimulation. Additionals, we propose a "magnetoelectric massager" strategy based on alternating magnetic field (AMF)-triggered on-demand NO release and electrical stimulation to restore brain function in traumatic brain injury. The NO and electron transport system was constructed as a metal-organic framework (MOF)-derived molybdenum carbide octahedron (MoCx-Cu) and an NO donor (S-nitrosoglutathione, GSNO), which was embedded in an implantable silk in a microneedle. Under AMF irradiation, eddy currents on conductive MoCx-Cu induced NO release from GSNO through electrical stimulation, thereby significantly promoting the differentiation and growth of neural stem cell (NSC) synapses. A combined strategy of in vivo traumatic brain injury allows NO and electrical stimulation-mediated inhibition of inflammation, angiogenesis, and neuronal interrogation.

Mr. Yi-Chen Chuang, Ms. Gi-Yi Huang, Mr. Chuang-Wei Tseng, Mr. Ping-Hua Chen, Dr. Min-Ren Chiang, Dr. Kang-Li Wang, Prof. Shang-Hsiu Hu, Mr. Chia-Ko Chen, Ms. Ping-Hsuan Huang, Ms. Chia-Yuen Hsu, Ms. Yun-Yan Kuo, Ms. Shih-Lin Chu, Ms. Wan-Chi Pan, Ms. Mong-Sing Wu, Ms. Shin-Yu Shi, Ms. Wan-Yu Yan.

Research Highlights

- 2022 MOST Outstanding Research Award
- 2022 National Innovation Award- Academic Innovation
- 2022 Future Tech Award
- 2022 Research Award on Biomadical Engineering of Prof. Chao-Ren Lee.

Research Output

- Yi-Chieh Chan, Ya-Hui Lin, Hsiu-Ching Liua, Ru-Siou Hsu, Ming-Ren Chiang, Li-Wen Wang, Tsu-Chin Chou, Tsai-Te Lu, I-Chi Lee, Li-An Chu*, Shang-Hsiu Hu*, In Situ Magnetoelectric Generation of Nitric Oxide and Electric Stimulus for Nerve Therapy by Wireless Chargeable Molybdenum Carbide Octahedrons, Nano Today, 2023, 51, 101935.
- Bhanu Nirosha Yalamandala, Thi My Hue Huynh, Min-Ren Chiang, Wei-Han Weng, Chien-Wen Chang, Wen-Hsuan Chiang, Shang-Hsiu Hu*, Adv. Funct. Mater. 2022, 2210644.
- Ru-Siou Hsu, Ssu-Ju Li, Jen-Hung Fang, I-Chi Lee, Li-An Chu, Yu-Chun Lo, Yu-Jen Lu*, You-Yin Chen*, Shang-Hsiu Hu*, Nat. Comm. 2022, 13, 5172.
- Wei Cheng, Yu-Lin Su, Hao-Hsiang Hsu, Ya-Hui Lin, Li-An Chu, Wei-Chen Huang, Yu-Jen Lu, Chi-Shiun Chiang, Shang- Hsiu Hu*,ACS nano, 2022, 16, 3, 4028.

04

Materials Science

Main-chain engineering of polymer photocatalysts with hydrophilic non-conjugated segments for visible-light-driven hydrogen evolution

High-Rate and Stable Lithium-Ion Battery Anode: A Hierarchically Porous MoS2 Foam in Three Dimensions

Ternary chalcogenide anodes for high-performance potassium-ion batteries and hybrid capacitors via composition-mediated bond softening and intermediate phase

05

Humanities and Social Sciences

The Application of Just Transition to evaluate Taiwan's Energy Transition and Nuclear-free Homeland Policy since 2016

Cross-cutting issues related to real estate research

How to "improve" prediction using behavior modification

Discourses on Chinese Lyrical Tradition and Literary Historiography