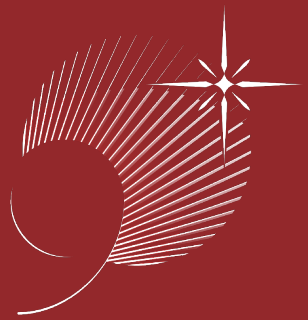
NCKU Academy of Innovative Semiconductor and Sustainable Manufacturing

智慧與永續製造學位學程

Program on Smart and Sustainable Manufacturing



Unite around One Torch
Stand Firm through Time as One

Achieve Securely · Prosper Mutually

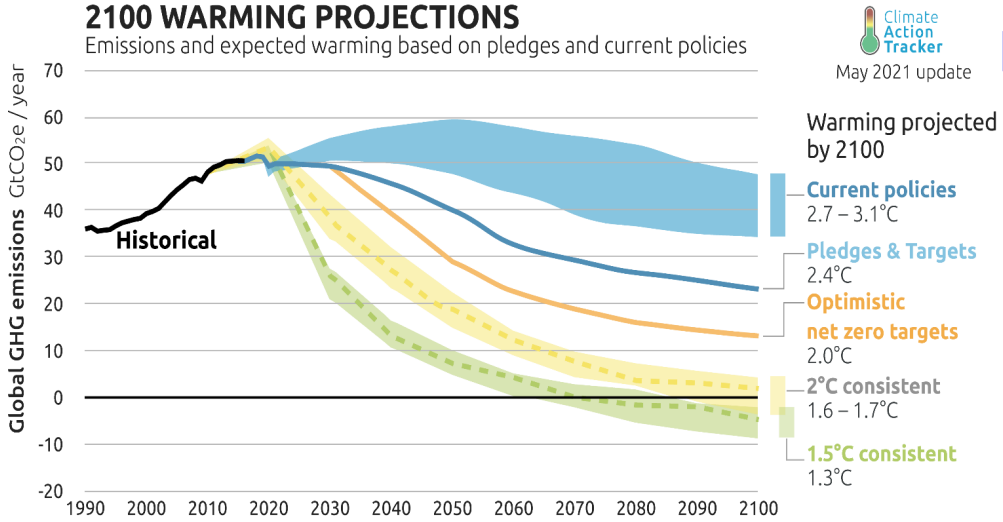
2026/11/02

游聲盛(Sheng-Sheng Yu)



Founded under the Act for National Key Fields Industry-Academia Cooperation and Talent Cultivation in August, 2021

Sustainable Manufacturing for Climate Challenges



Key Concept and Curriculum

- Carbon Neutrality
- Circular Economy
- Renewable Energy

SUSTAINABLE DEVELOPMENT GOALS

7 AFFORDABLE AND CLEAN ENERGY

SDG 7 Affordable and Clean Energy NCKU World ranking	2019	2020	2021	2022
	-	★ 20	★ 88	★ 8

Carbon Neutrality @ NCKU (NCKU 2030)

Replacement of Carbon

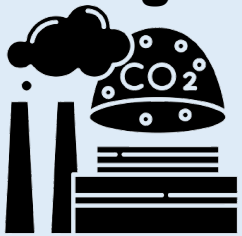


- Hydrogen Production
- Hydrogen Metallurgy/Fuels



+

CO_2 Capture & Usage



The first “Negative Emission Plant” in Taiwan



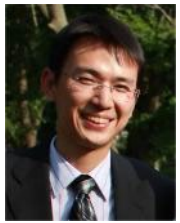
=

CO_2 Reduction

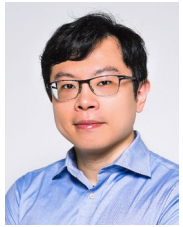




About Program on Smart and Sustainable Manufacturing



Prof. Shih-Kang Lin (林士剛)
Program Director, PSSM, AISSM
Distinguished Professor,
Department of Materials Science & Technology



Prof. Sheng-Sheng Yu (游聲盛)
Deputy Director, PSSM, AISSM
Professor,
Department of Chemical Engineering



Over 40 faculty members affiliated in PSSM !



About Program on Smart and Sustainable Manufacturing

Research Topics

- Intelligent manufacturing technology and circular economy
- Sustainable manufacturing and low-carbon metallurgical technology

Team members from various fields

48

- Aeronautics and Astronautics
- Biomedical Engineering
- Chemical Engineering
- Electrical Engineering
- Engineering Science
- Environmental Engineering
- Manufacturing Information and Systems
- Materials Science & Engineering
- Mechanical Engineering
- Resources Engineering

Industry Partners

- **China Steel**
- **LCY Group**
- **Taya Group**
- **Applied Materials Taiwan**
- **Industrial Technology Research Institute, ITRI**

LCY GROUP

TAYA GROUP 大亞集團

AISM

Course work



Master degree students

- **4** seminar courses
- **6** credits of Mandatory courses (One AI course and one sustainability course)
- **18** credits of selective courses
- **6** credits of thesis

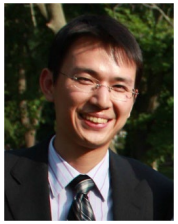
Ph. D. degree students

- **4** seminar courses
- **6** credits of Mandatory courses (One AI course and one sustainability course)
- **12** credits of selective courses
- **12** credits of thesis

List of Mandatory courses

- Introduction to Artificial Intelligence (3 credits)
- Big Data and Cloud Computing (3 credits)
- Intelligent Manufacturing Systems (3 credits)
- Introduction to Sustainable Energy (3 credits)
- Materials and Devices for Sustainable Energy (3 credits)

Hydrogen Usage: Hydrogen-based ironmaking process for green steel



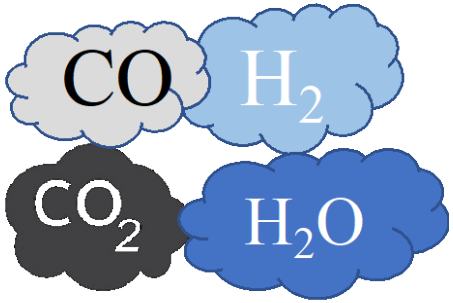
Prof. Shih-Kang Lin (林士剛)
Program Director, PSSM, AISSM
Distinguished Professor,
Department of Materials Science & Engineering

85% of the total CO_2 emission from blast furnace!

Hydrogen-rich Metallurgy (Thermodynamics & Kinetics)

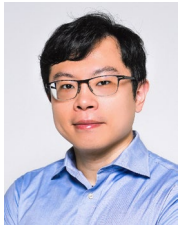
Hydrogen-rich gas injection





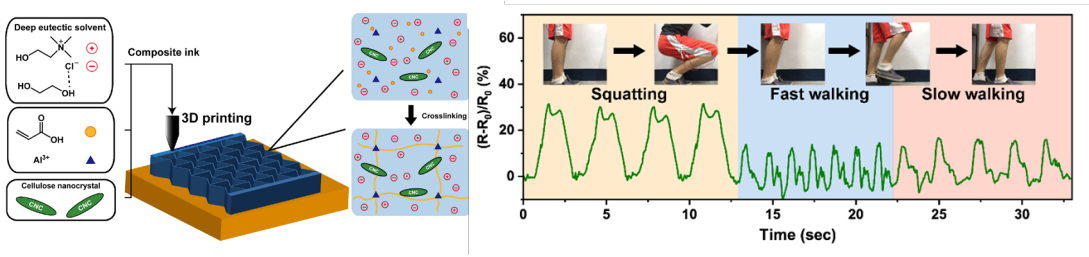
Top Gas (BFG) Recycle/Reforming/ Reinjection (CCU)

Smart Manufacturing

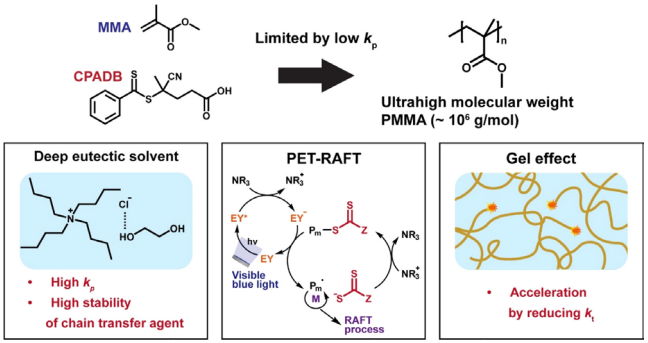


Prof. Sheng-Sheng Yu (游聲盛)
Deputy Director, PSSM, AISSM
Professor,
Department of Chemical Engineering

Utilizing cellulose for 3D printing of wearable sensors

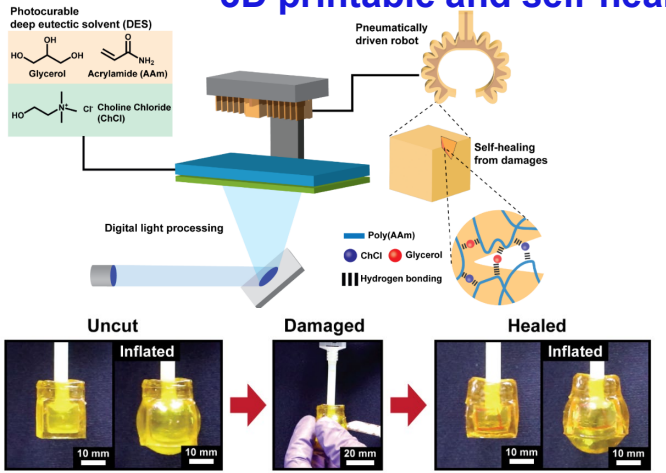


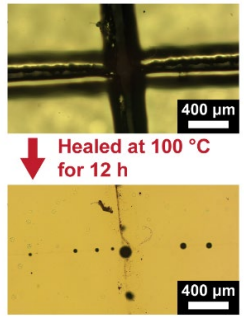
Sustainable solvent for rapid production of polymers





3D printable and self-healable soft robot



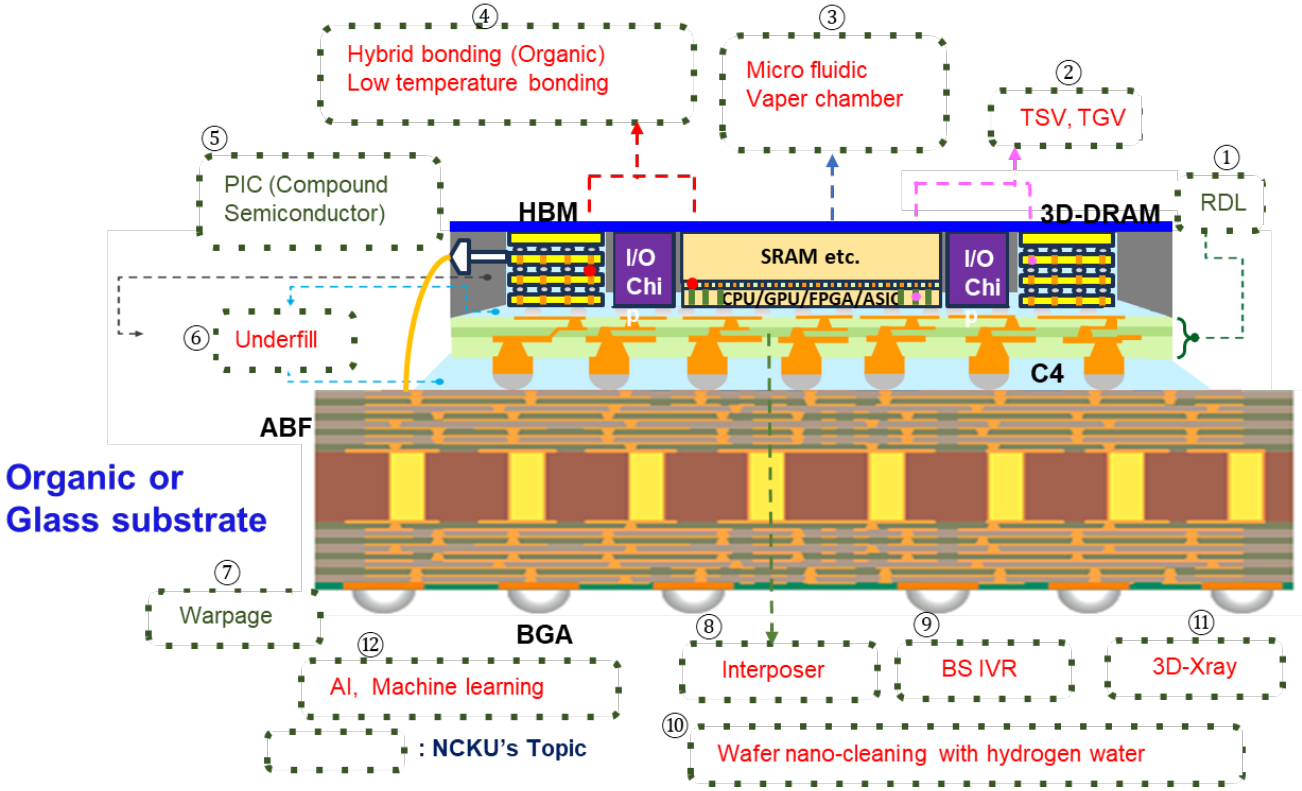


Smart Manufacturing



Prof. Jun Mizuno (水野潤)
Professor, PSSM, AISSM
Associate Professor,

Next Generation Heterogeneous Integration





Predictive Multiscale Simulation for Semiconductor Manufacturing

Experiment-calibrated models connect atomic mechanisms to device- and wafer-scale outcomes.

Our group website

DFT → Machine-Learning Interatomic Potentials → Multiphysics FEA → Manufacturing Prediction

Ph.D. Hong-Kang Tian(田弘康)
Associate Professor

Department of Chemical Engineering

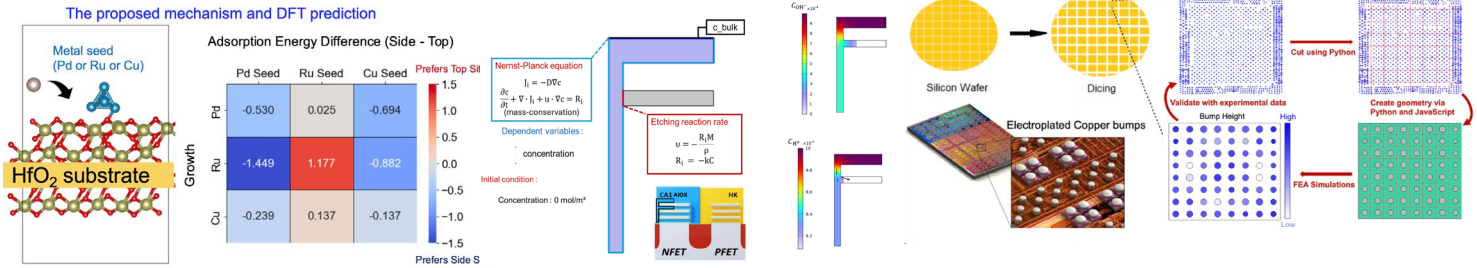
Joint appointment

Academy of Innovative Semiconductor & Sustainable Manufacturing

CORE METHODS

First-principles calculations
Machine-learning potentials
Multiphysics modeling

hktian@gs.ncku.edu.tw
tian-group-ncku.com



ATOMIC SCALE

DFT + MLIPs

Materials, interfaces & deposition

DEVICE / FEATURE SCALE

Multiphysics FEA

Wet cleaning, lateral etching & transport mechanisms

WAFER / PACKAGING SCALE

Automated prediction

Electroplating uniformity & coplanarity

Semiconductor industry collaboration

ASE · 2026–27 Wafer electroplating height-uniformity prediction for advanced packaging
TSMC · 2025–26 Wet chemical cleaning and lateral etching of small trenches and nanosheets
ASE · 2023–24 Electroplating model for higher deposition rate and improved coplanarity

COLLABORATION OPPORTUNITIES Process digital twins · Advanced packaging · Semiconductor materials & interfaces · MLIP-enabled modeling

Smart Manufacturing



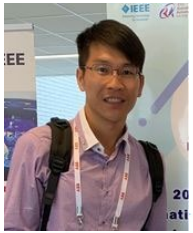
Prof. Fan-Tien Cheng (鄭芳田)
Institute of Manufacturing Information and Systems



Prof. Pei-Yin Chen (陳培殷)
Department of Computer Science and Information Engineering

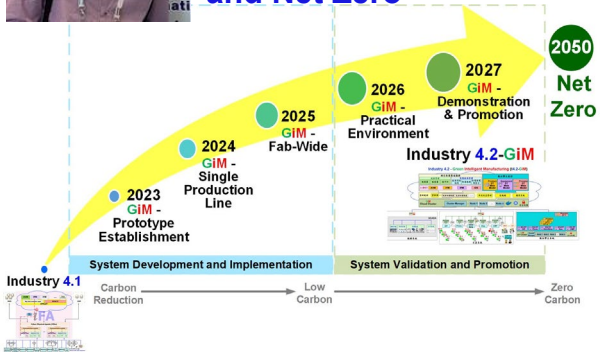


Prof. Wei Wu (吳煒)
Department of Chemical Engineering



Prof. Yu-Ming Hsieh (謝昱銘) PSSM, AISSM

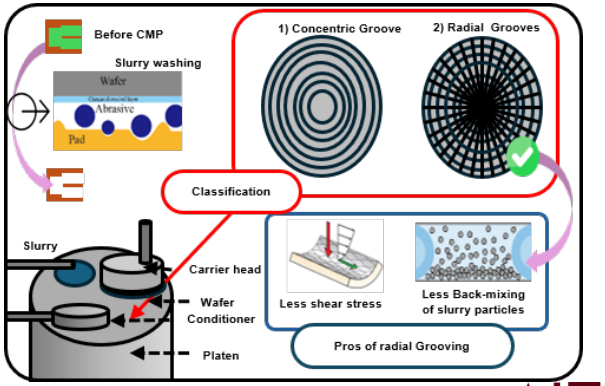
Intelligent Manufacturing with Zero Defects and Net Zero



Design of various low-complexity, high-efficiency algorithms and their VLSI digital circuits.

1. Image processing such as scaling, De-Fogging and Enhancing.
2. Post-Quantum Cryptography (circuits for FIPS-203, 204, 205)

- Computational fluid dynamics (CFD) models to simulate slurry flow between the wafer and polishing pad.
- Life cycle analysis (LCA)



Take away and Contact information

跨域融合 永續創新

Discipline Integration for Sustainable Innovation –

The Academy integrates scientific knowledge and engineering expertise across disciplines, pioneers cutting-edge technologies, nurtures potential talents, and advances next-generation sustainable development for the semiconductor industry.

Thank you!

Prof. Shih-Kang Lin (林士剛)
linsk@mail.ncku.edu.tw

Prof. Sheng-Sheng Yu (游聲盛)
ssyu@mail.ncku.edu.tw