

# Introduction to the

# CROSS LABORATORY



東京科学大学 環境・社会理工学院 融合理工学系 クロス研究室

Institute of Science Tokyo, School of Environment and Society  
Transdisciplinary Science and Engineering



# Prof. Jeffrey S. Cross

## About

### ● Education

- 1988-1992 Ph.D., Major: Ch.E., Minor: Mater. Sci., Iowa State University, Ames, IA, USA
- 1986-1988 M.S., Ch.E., University of Arkansas, Fayetteville, AR, USA
- 1982-1986 B.S., Ch.E., Kansas State University, Manhattan, KS, USA (Honors program)

## Teaching

- **Graduate courses**
  - Academic Writing
  - Energy & Environment
- **Undergraduate courses**
  - Online course creation
  - Video-making
  - Engineering Measurements
  - Materials and Molecular Engineering



# Prof. Jeffrey S. Cross

## Career in Japan

- 1993 arrived at NIRIM, Tsukuba, Japan as NSF Post-doc fellow
- 1994 CGP-NSF Post doc fellow, Fujitsu Lab Ltd., Atsugi, Japan
- 1996 Fujitsu Lab Staff Researcher, Semiconductor Memories
- 2002 Part-time visiting Assoc. Prof. Tokyo Tech
- 2004 Fujitsu Lab Group Leader, Memory Reliability
- 2008 Professor Tokyo Tech, International Engineering Programs
- 2014 Created Online Education Development Office, edX Member
- 2016 Started Cross Lab for research and lab based education





# General Manager

# OCRD

Online Content Research and Development Section



# TokyoTechX

**Japanese Architecture and Structural Design**  
Tokyo Institute of Technology

**Introduction to Electrical and Electronic Engineering - 電気電子...**  
Tokyo Institute of Technology

**Introduction to Computer Science and Programming**  
Tokyo Institute of Technology

**Introduction to Business Architecture**  
Tokyo Institute of Technology

**Basic Japanese Civil Law 2**  
Tokyo Institute of Technology

**Graduate Studies in Japan**  
Tokyo Institute of Technology

**Introduction to Deep Earth Science**  
Tokyo Institute of Technology

**Modern Japanese Architecture Part 1: From Meiji Restoration to the...**  
Tokyo Institute of Technology

**Modern Japanese Architecture: From Meiji Restoration to Today**  
Tokyo Institute of Technology

**Autophagy: Research Behind the 2016 Nobel Prize in Physiology or...**  
Tokyo Institute of Technology

**将棋で学ぶプログラミング...**  
Tokyo Institute of Technology

**超スマート社会への招待 | Introduction to the Super Smart Society**  
Tokyo Institute of Technology

# Prof. Cross' other activities

- Science Tokyo International research exchange committees
- Science Tokyo International admissions working group
- Sports: Badminton, American Dodgeball, Cycling, Golf...
- Food Sports: Kansas City BBQ Society Judge and BBQ website







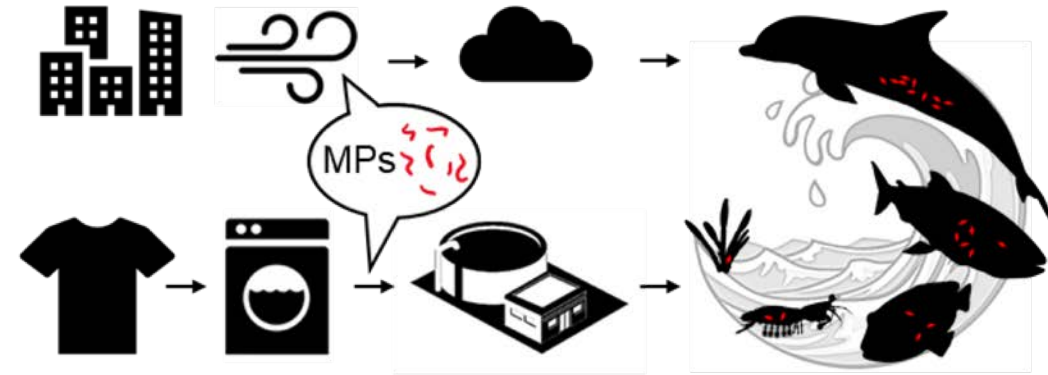
# Assistant Prof. Cheng Shuo (Tei)

## Education:

- Environmental Science and Technology, Interdisciplinary Graduate School of Science and Engineering, Tokyo Institute of Technology, Japan
- 2013-2016 Ph.D.
- 2011-2013 M.S.

## Research:

- Hazardous waste treatment, environmental/ecotoxicology, microbial fuel cells



Ecotoxicological studies about MPs

Ecological risk assessment of MPs

Risk management policy for MPs control



# Dr. Sasipa Boonyubol

- Lecturer -



## • Education:



**SIIT**  
Sirindhorn International Institute of Technology

B. Eng  
(Thailand)  
-2013-



東京工業大学  
Tokyo Institute of Technology

M. Eng  
(Japan)  
-2016-



東京工業大学  
Tokyo Institute of Technology

D. Eng  
(Japan)  
-2020-

## • Undergraduate courses:

- Engineering Thermodynamics
- Visionary Project
- Biological Engineering
- Engineering Measurements
- Industrial Chemistry

## • Research:

- Hydrogen separation membrane

# Visiting researchers



**Tokyo Tech Emeritus  
Prof. Koichi MIKAMI**

Research area:

- Asymmetric Synthesis
- Drug Design
- Organofluorine
- Organometallic
- Material Design



**Dr. Nopphon Keerativoranan  
Post-doc**

Research and activities:

- Personalized learning
- Machine learning
- Support research activities related to Education Technology



# Thai visiting researcher and student



**Assoc. Prof. Chinnathan Areeprasert, D.Eng.**

(Visiting Associate Professor at Science Tokyo)

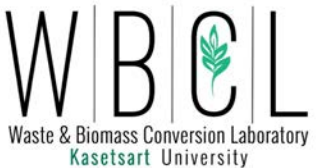
- Department of Mechanical Engineering, Faculty of Engineering, Kasetsart University
- Research area: Hydrothermal Processing of Biomass; Thermochemical Conversion of Waste/Biomass; Waste Management; Hydrogen Production from Biomass Gasification

**Current Funding:** World Research Hub (WRH) and– Fundamental Fund

**Submitted Funding (Wait for the result)**

- **2025 NRCT-JSPS** (Novel metallic membrane for high purity hydrogen gas separation made from e-waste copper)
- **2025 PMUB-JST** (Driving Sustainable Mobility with Biochar Gasification and Hybrid Separation Technologies for Green Hydrogen in FCEVs)

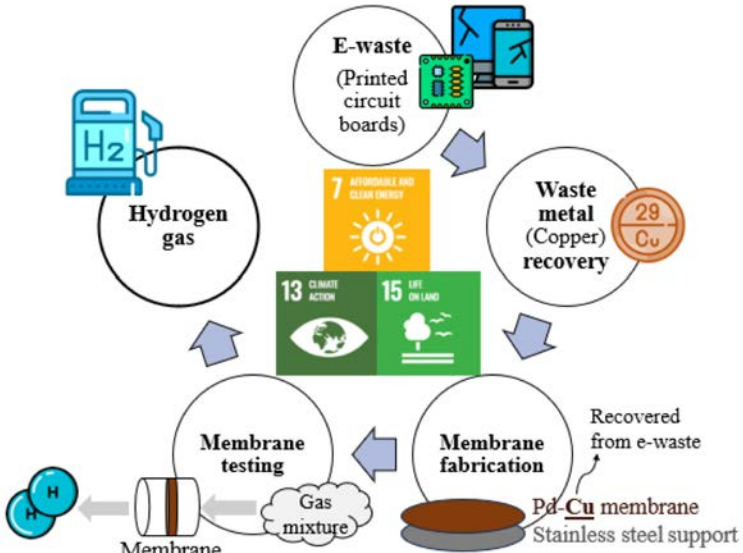
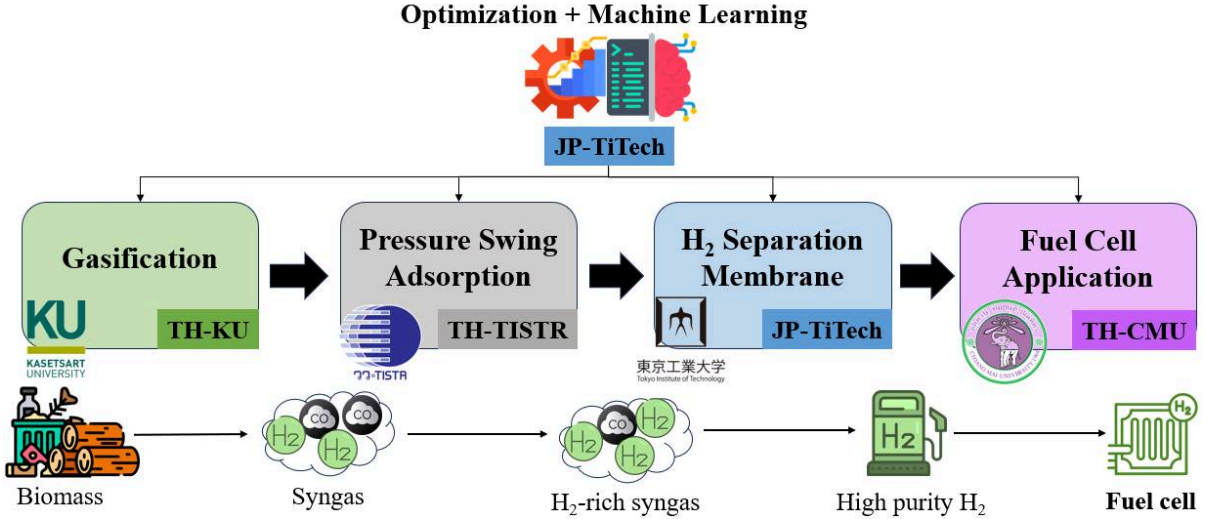
Assoc. Prof. Chinnathan



<https://wbc-lab.com/>

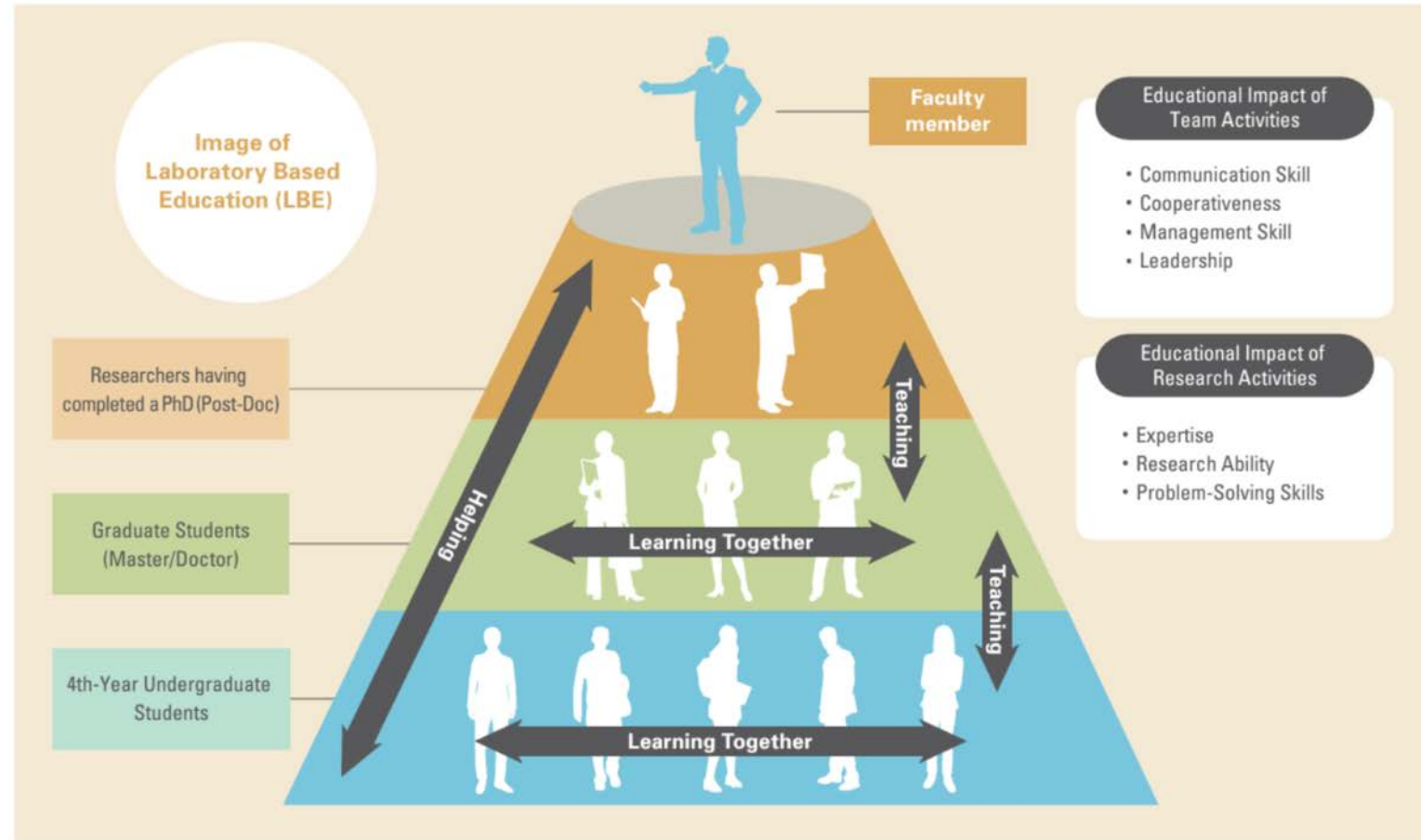


Mr. Nutthaphon (Kasetsart University master's degree exchange student)



# Research Project Management (all students)

- Discuss research topic
- Redefine topic
- Literature gap
- Research Proposal
  - Literature review
  - Research Objective
  - Research Questions
  - Plan & budget
  - Outcome



# Current students

- **Current students: 18**

- Doctoral students: 11
- Master's students: 4
- Bachelor's student: 1
- Research student: 1
- Exchange student: 1

- **Students' nationalities:**

- Bangladesh, Cambodia, Canada, China, India, Indonesia, Japan, Malaysia, Pakistan, Thailand, Trinidad/Tobago, Togo, USA

- **Diversity of students' nationalities**

- English as a lingua franca

## Biofuels group



Harussani  
(D3)



Eric  
(D1)



Md. Rubel  
(D1)



Ishikawa  
(D1)



Aldian  
(Research student)



Nutthaphon  
(YSEP exchange student)

## Environmental toxicology group



Kimleng  
(D2)



Snehal  
(D1)



Haoge  
(M1)

## Edtech group



Luc  
(D3+)



Tony  
(D3+)



Don  
(D1)



Yipeng  
(M2)



Yuka  
(M1)



Tomohiro  
(B4)

## Energy policy group



Avinash  
(D3)



Jinesh  
(D1)



Muneaki  
(M2)



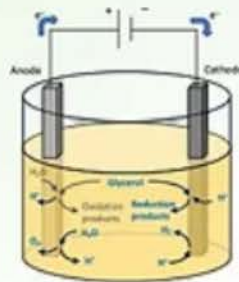
# Biofuels Research Group



The **Biofuels research group** transforms wastes and sewage sludge into fuels, chemicals, and materials by using knowledge of chemical engineering processes, catalysts, and machine learning. The group also develops Pd-Cu membrane technology for green hydrogen gas separation and storage. Contact Professor Cross for further information.



Waste glycerol



Electrocatalytic reduction



Alternative biofuel - biopropanol



Waste cooking oil



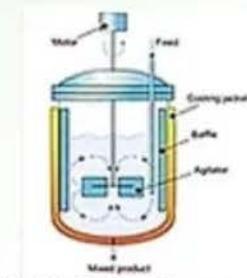
H<sub>2</sub> ↑ New Catalyst



Sustainable aviation fuel



Sewage Sludge



Lipids Extraction and Transesterification



Biofuel



Lignin



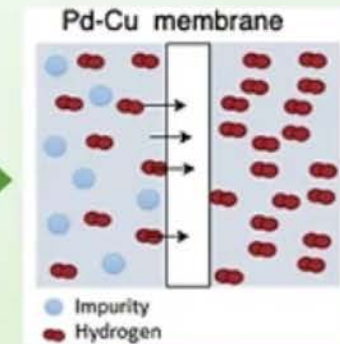
Depolymerization Aided by AI/Machine learning



Chemicals



waste stream gasification



separation of green H<sub>2</sub>

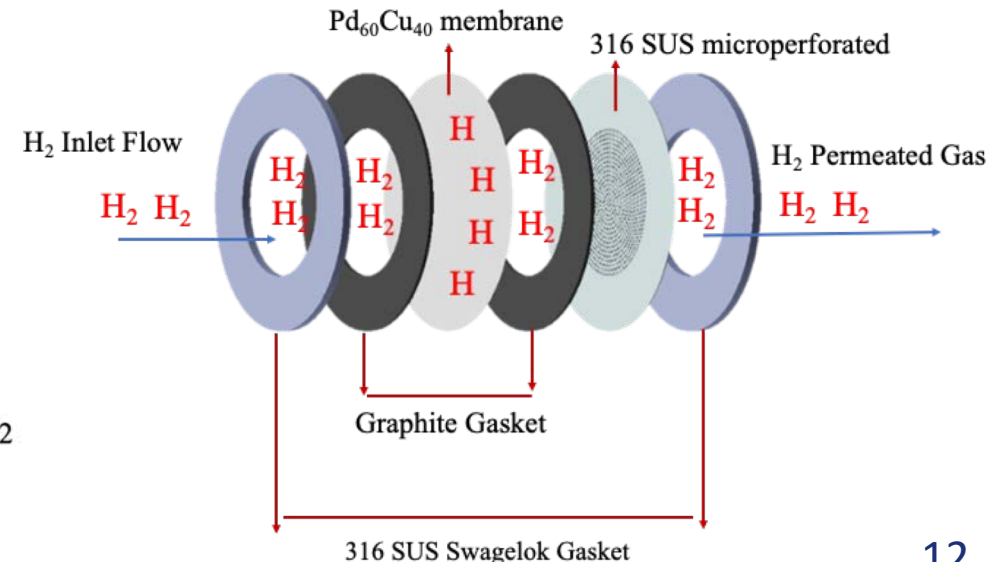
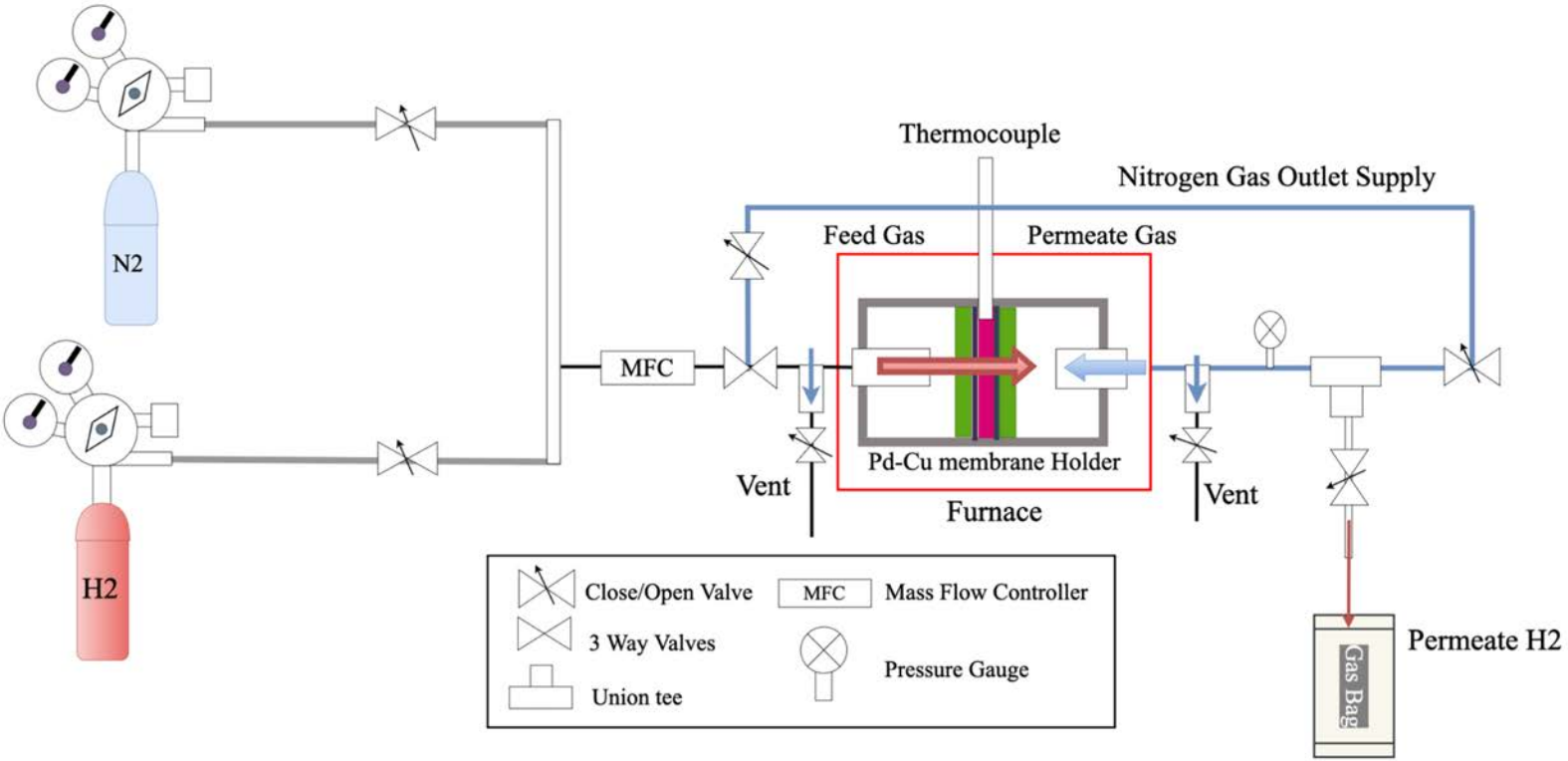
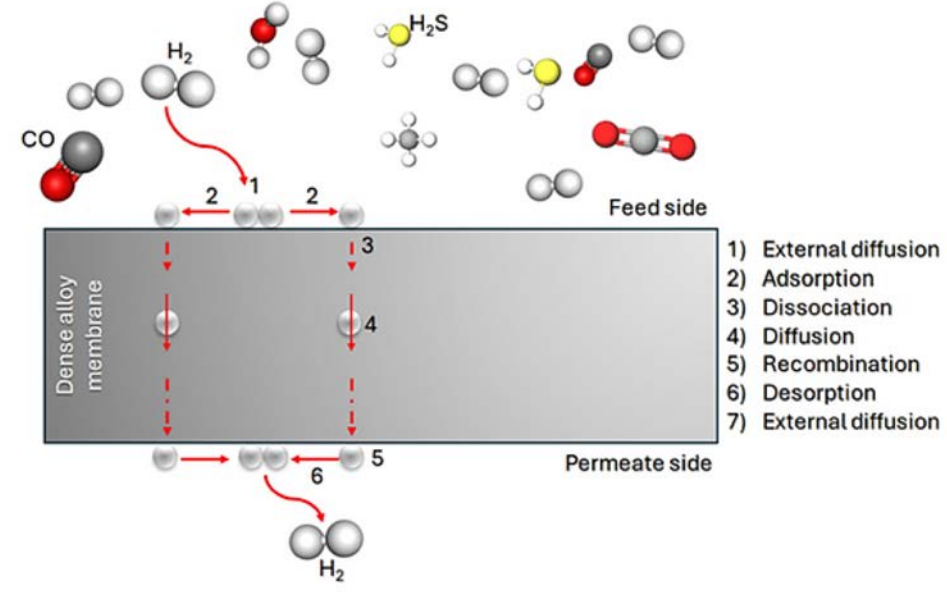


Green Hydrogen

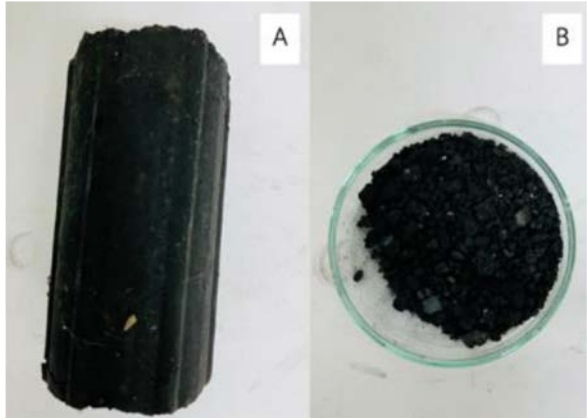
# Palladium Copper (PdCu) membrane-based hydrogen gas separation

Since 2021, the Cross lab has been undertaking hydrogen gas separation research using a Swagelok VCR based 20 cm diameter PdCu membranes of 10 and 15 microns thick, from Tanaka Kinzoku Ltd, Tokyo, Japan

Schematic of the mechanism of mixed gas separation using dense metal membranes



# Hydrogen production and separation

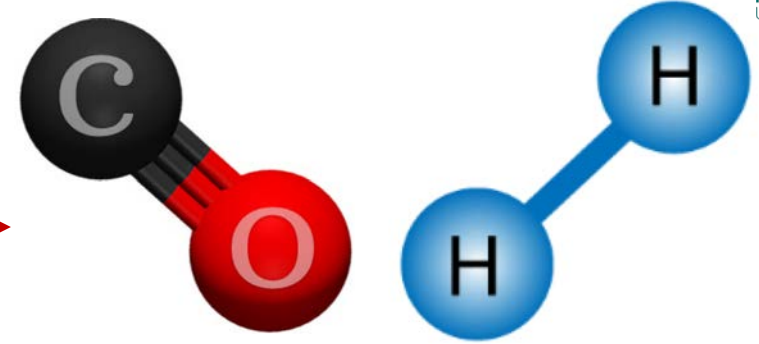


Coconut shell char [fuel]

700-800 °C

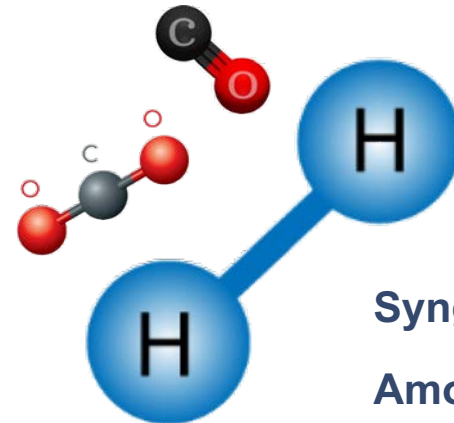


Gasifier

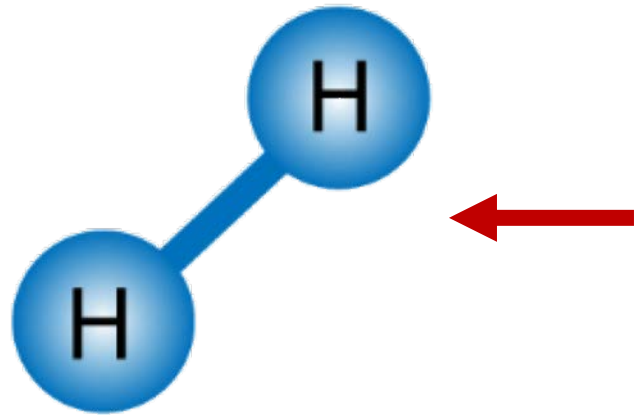


Syngas contain rich **Hydrogen**  
And **Carbon monoxide**

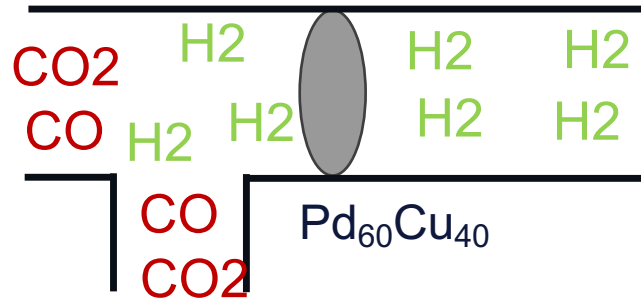
Water gas  
shift reaction  
(added steam)



Syngas contain higher  
Amount of **Hydrogen**



Pure **Hydrogen**



Hydrogen separation



# Alternative membrane production



Pyrolysis



Electrolysis

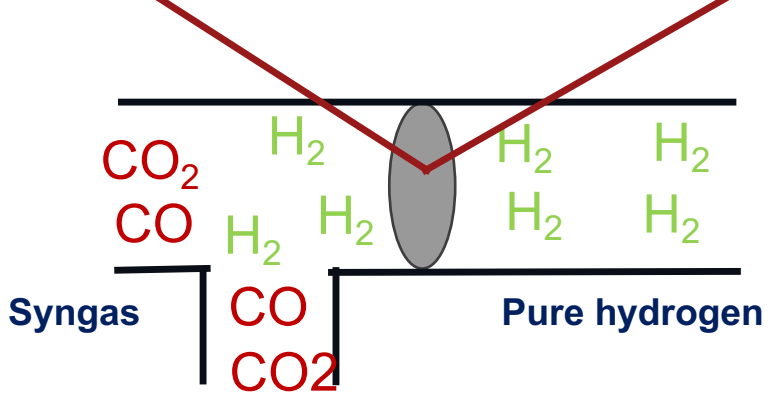
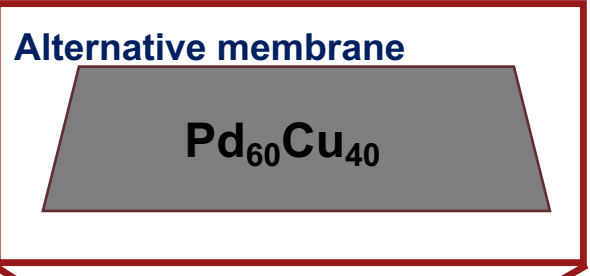


10% Copper powder

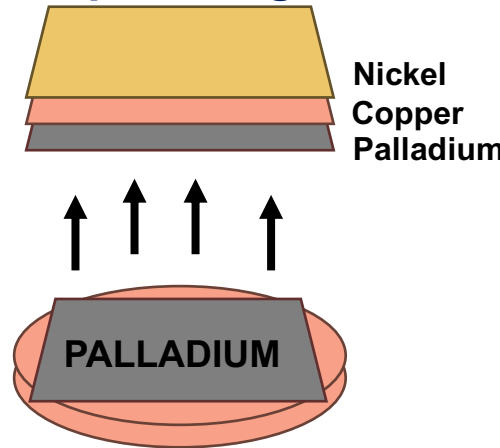
90% Copper wire

Wasted circuit board

Pyrolysis char Of printed circuit board



Sputtering

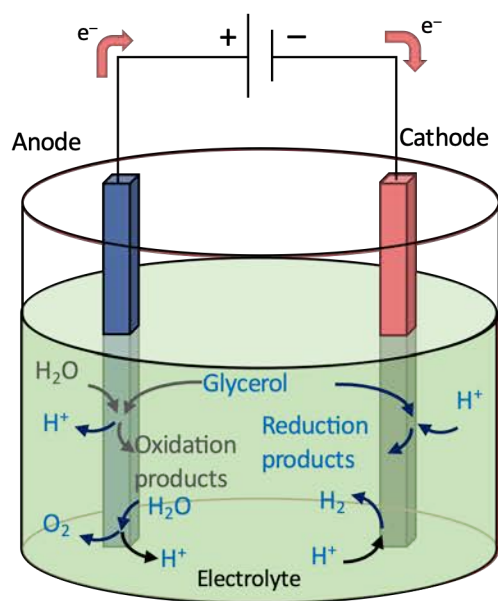
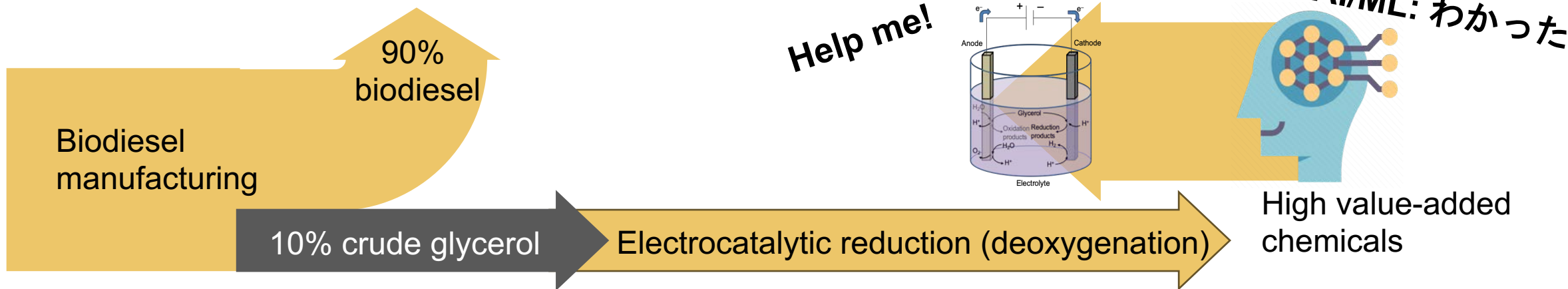


Melting

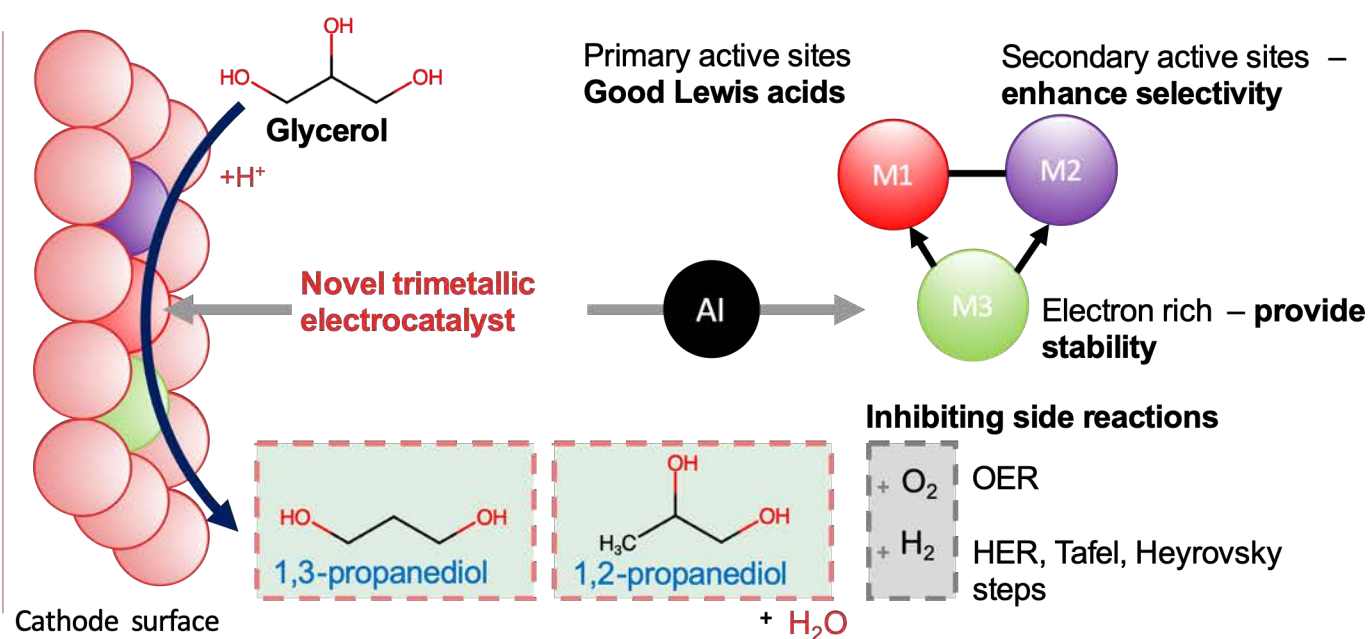


Alternative copper target

# Electrocatalytic reduction of glycerol assisted with machine learning

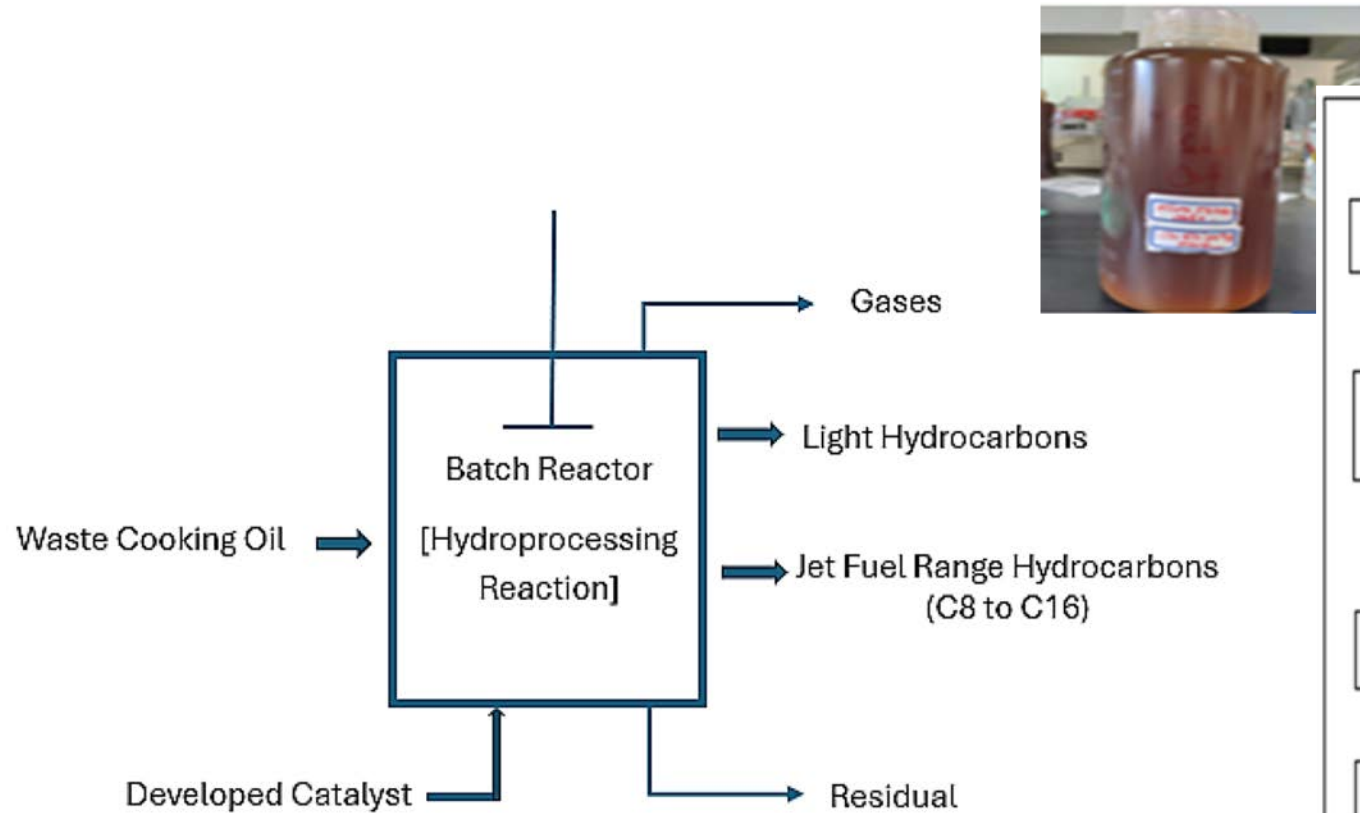


(a)

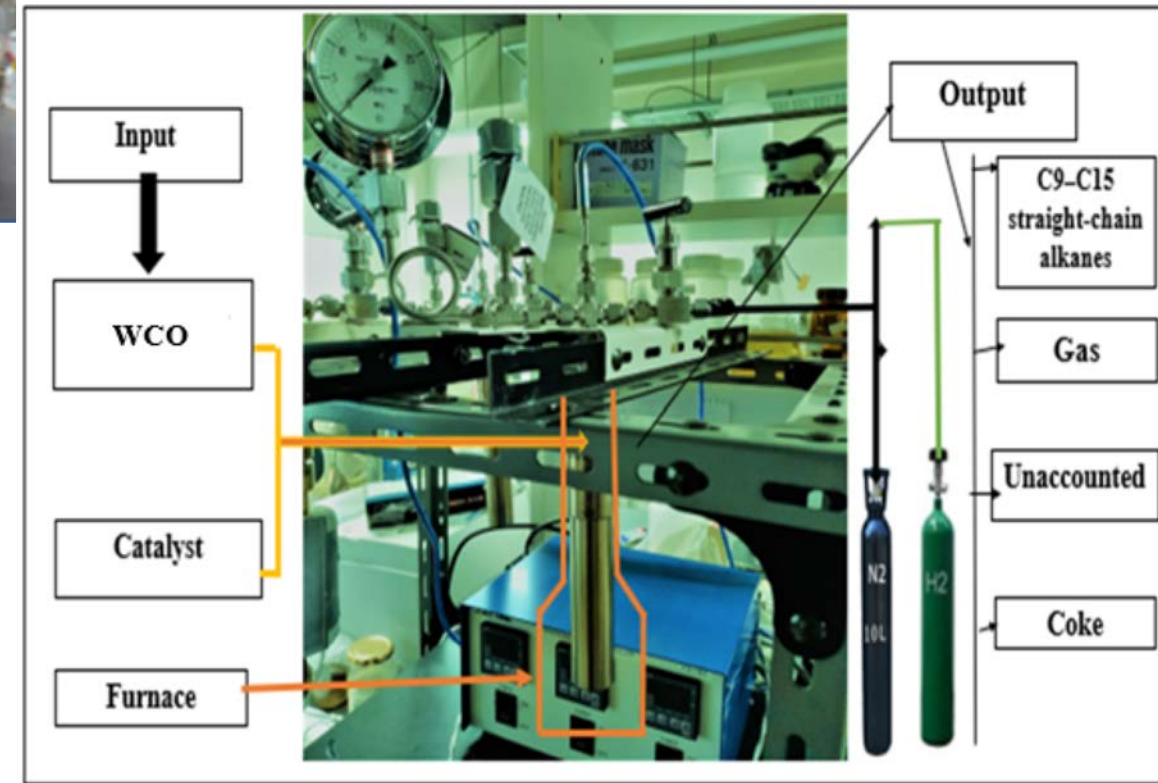


(b)

# Sustainable aviation fuel (SAF) synthesis from waste cooking oil (WCO)



Symmetric illustration of the Hydroprocessed Esters and Fatty Acids (HEFA) process

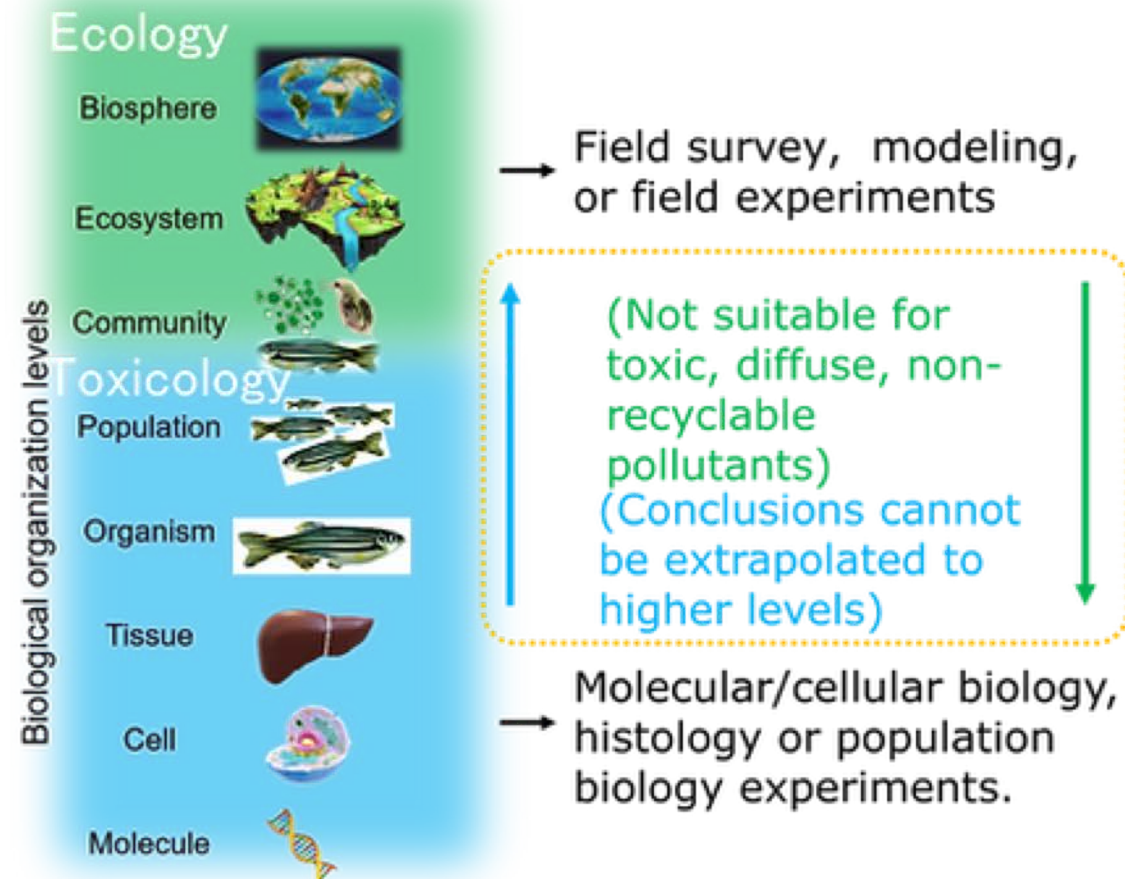
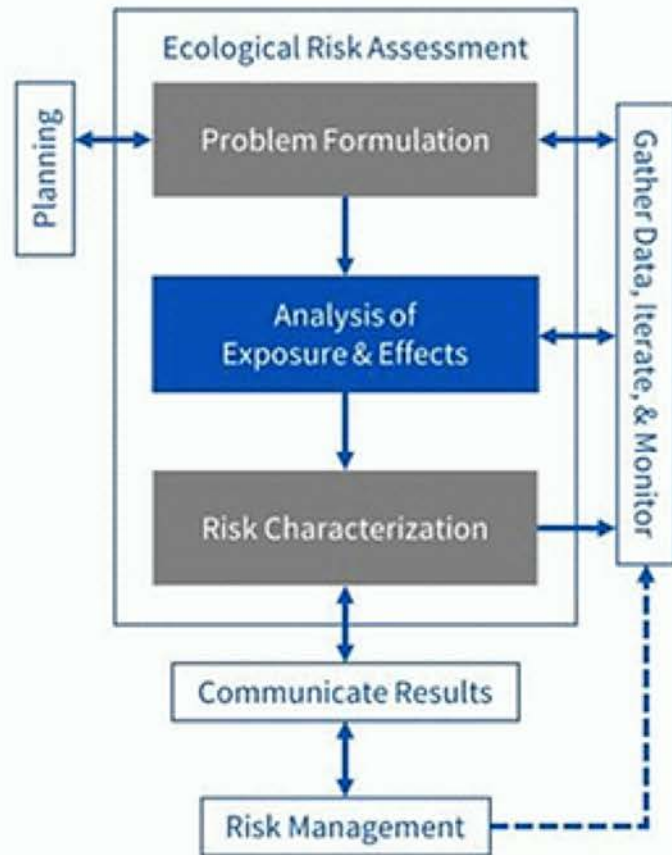


Schematic illustration of high-pressure reactor unit



# Environmental Toxicology Group

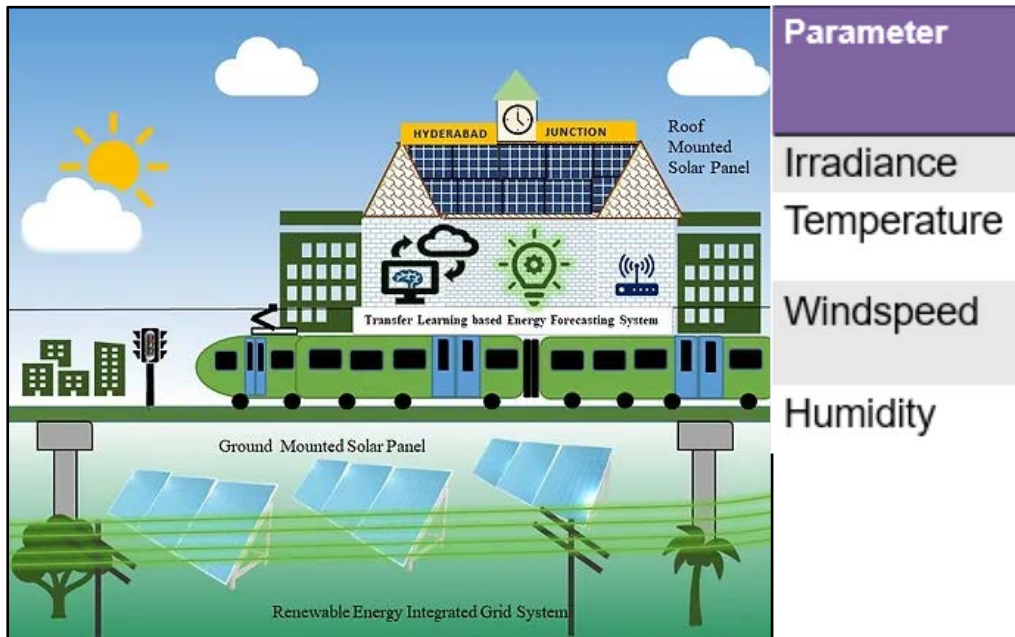
The Environmental Toxicology Group uses chemistry, environmental engineering, and energy engineering knowledge. Research delves into both fundamental theories and real-world applications. The research examines the impact of different pollutants on ecosystems, food chains, and the well-being of humanity.





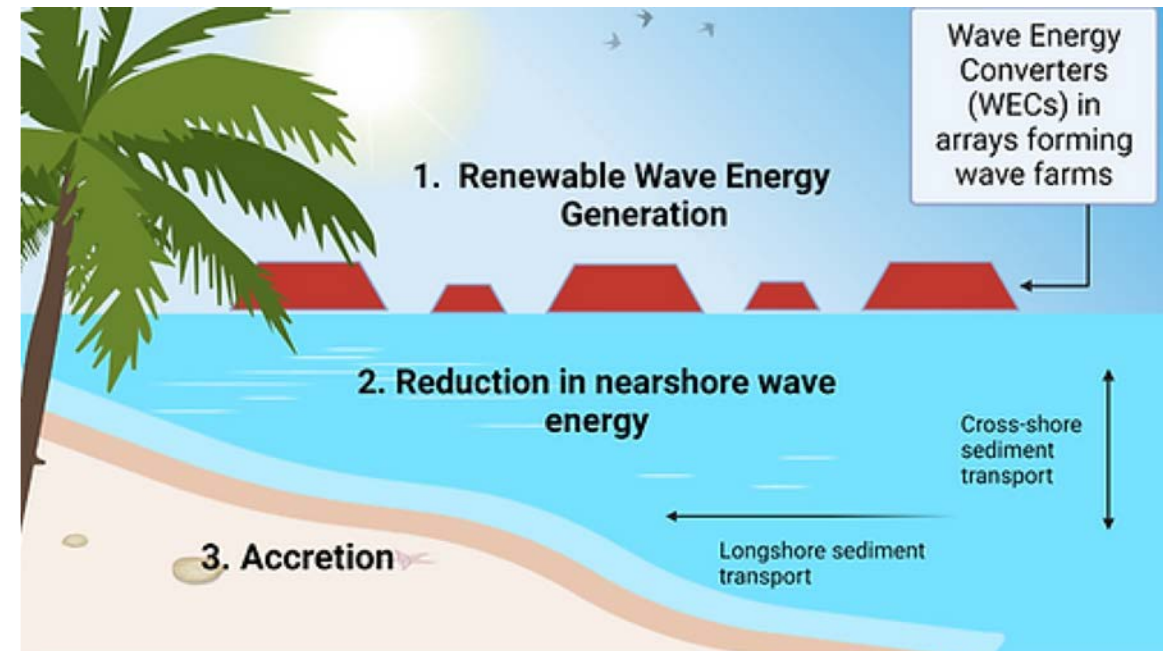
- Conducts research to develop models to provide energy solutions to the challenges faced by society

## Transfer Learning Method to Overcome Data Scarcity in Photovoltaic Power Estimation



Railway Station Solar Power Forecasting

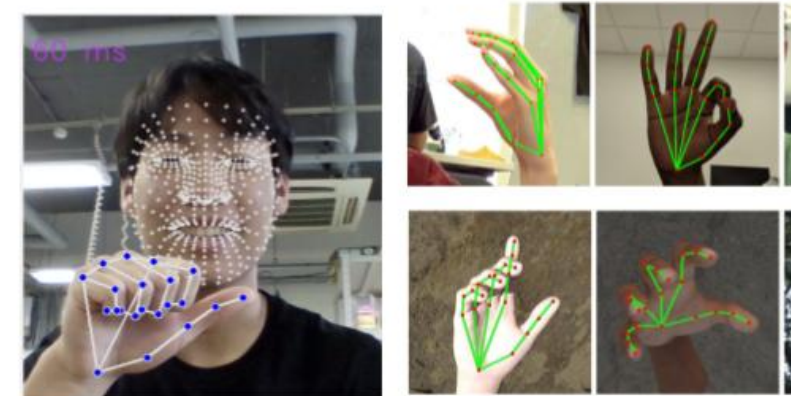
## The Dual Use of Wave Energy Converters and Wave Farms for Coastal Protection and Renewable Energy Generation



# Education Technology Research Group



- Design-based approaches to introduce improvements to education using technology
- Research topics:
  - Virtual Reality (VR) assisted English language and mathematics learning
  - Automated essay grading
  - Computer vision in sign language learning
  - Life-long learning
  - Computational thinking skills
  - Metacognition
  - Personalized learning
  - AI use in education of Japanese English language learners



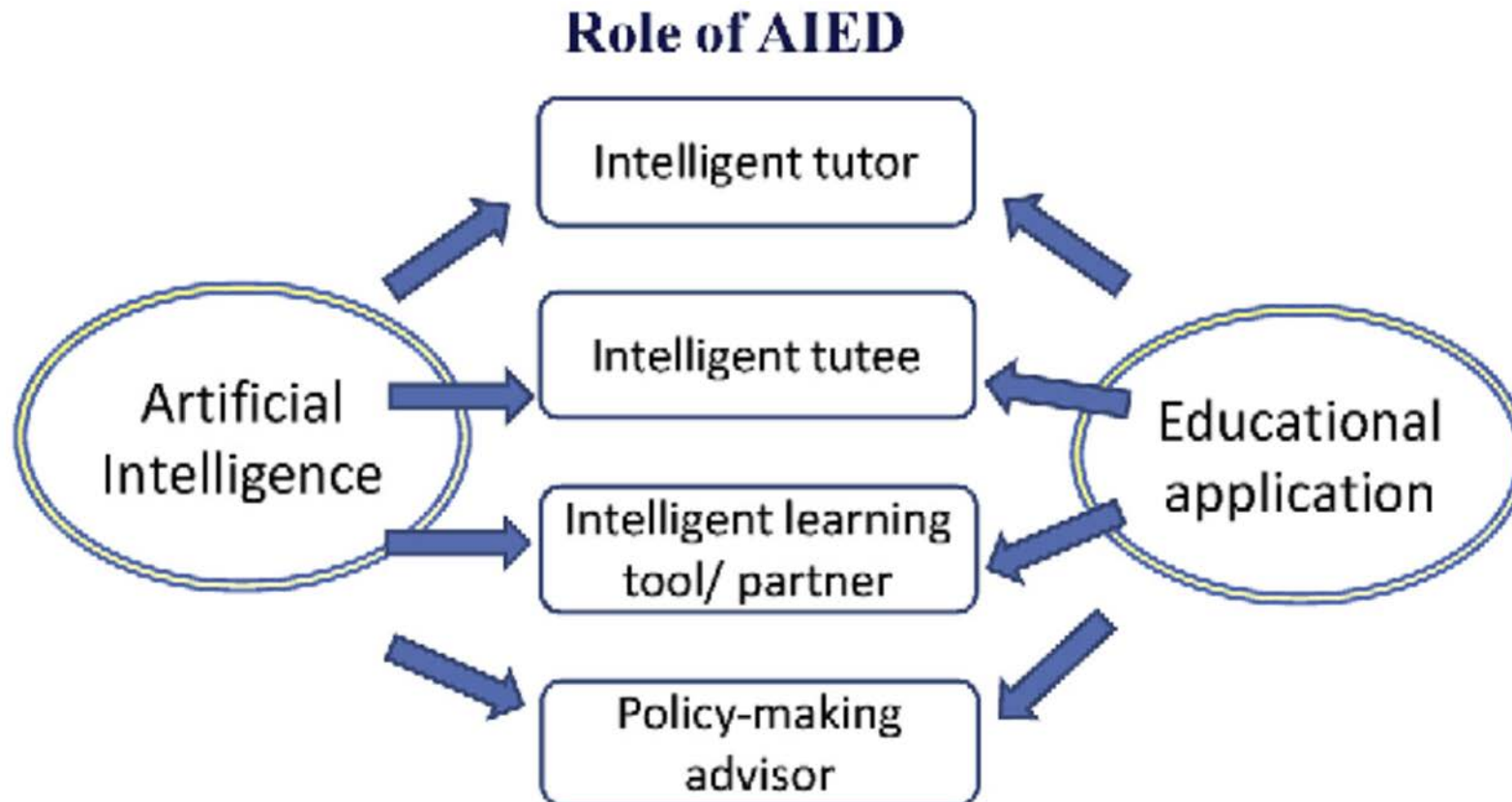


- Embodiment and Iconicity for English as a Foreign Language Learning in Virtual Reality

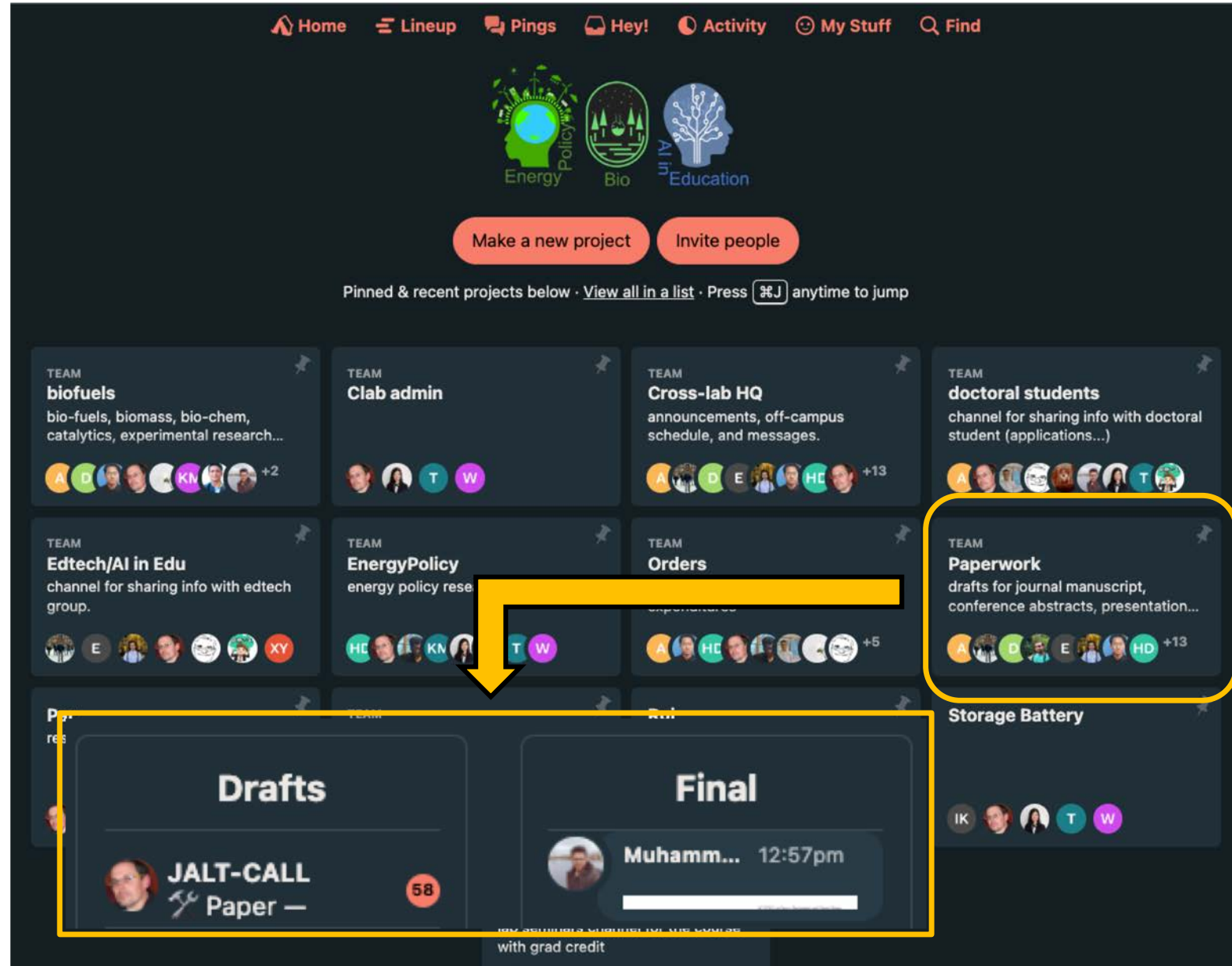


# Education Technology Research Group

- ChatGPT for personalized learning (language learning and mathematics)



# Computer aided lab-based education & PBL



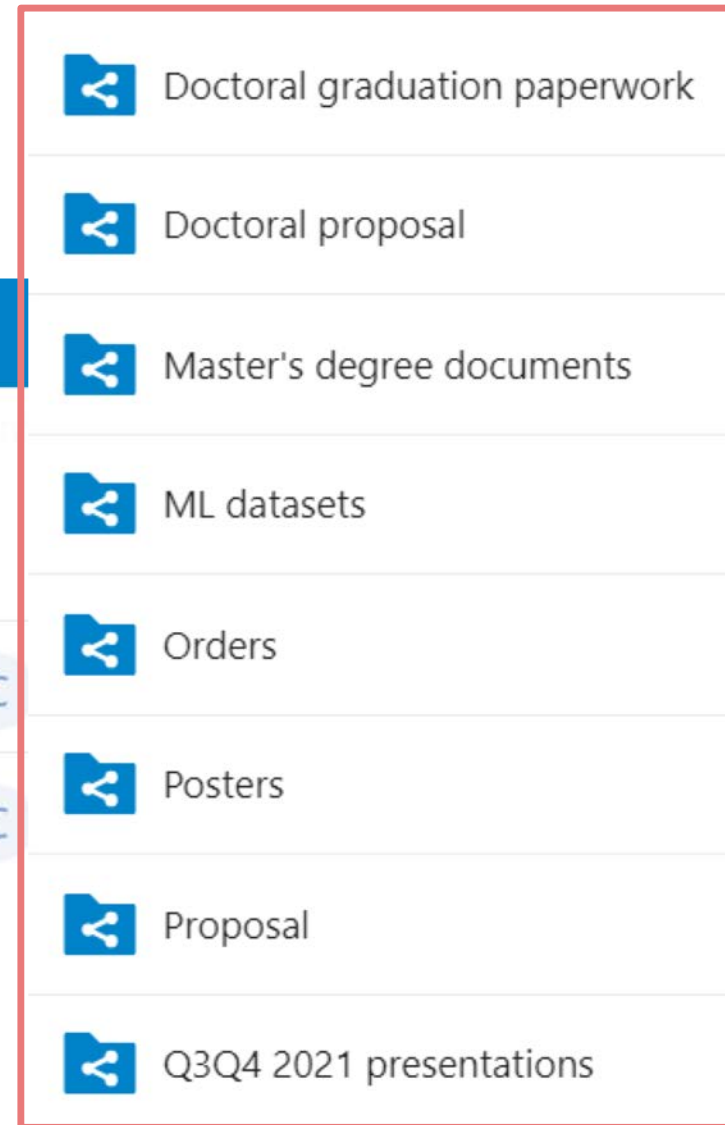
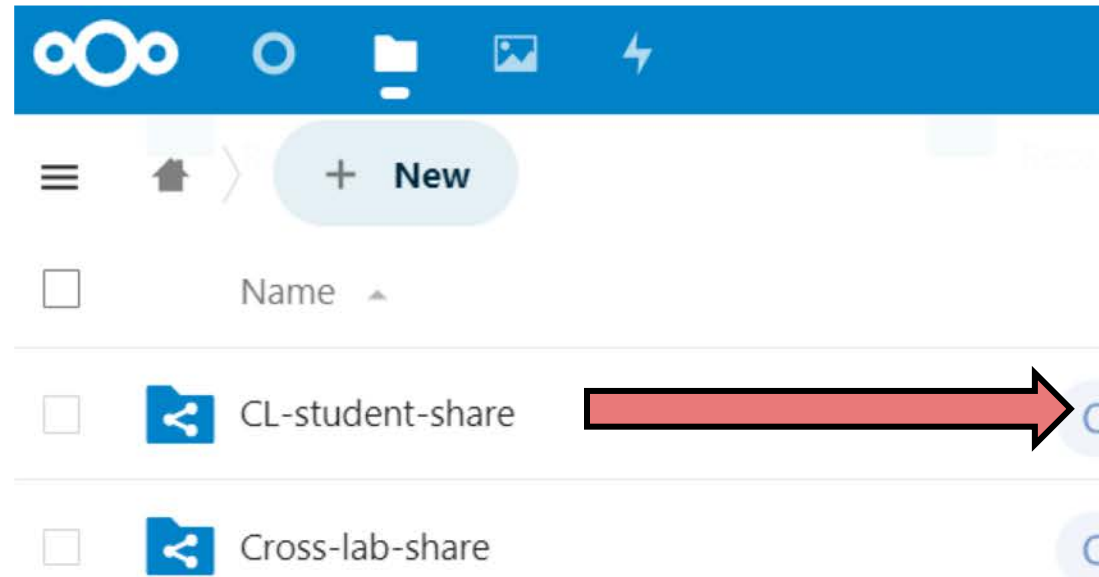
The screenshot shows a project management dashboard with a dark theme. At the top, there is a navigation bar with icons for Home, Lineup, Pings, Hey!, Activity, My Stuff, and Find. Below this are three circular icons representing 'Energy Policy', 'Bio', and 'AI in Education'. Two buttons, 'Make a new project' and 'Invite people', are visible. A section titled 'Pinned & recent projects below' includes a link to 'View all in a list' and a keyboard shortcut '⌘J'. The main area displays a grid of team channels:

- TEAM biofuels**: bio-fuels, biomass, bio-chem, catalytics, experimental research... (4 members)
- TEAM Clab admin**: (2 members)
- TEAM Cross-lab HQ**: announcements, off-campus schedule, and messages. (13 members)
- TEAM doctoral students**: channel for sharing info with doctoral student (applications...)
- TEAM Edtech/AI in Edu**: channel for sharing info with edtech group. (5 members)
- TEAM EnergyPolicy**: energy policy rese... (5 members)
- TEAM Orders**: (5 members)
- TEAM Paperwork**: drafts for journal manuscript, conference abstracts, presentation... (13 members)
- Storage Battery**: (3 members)

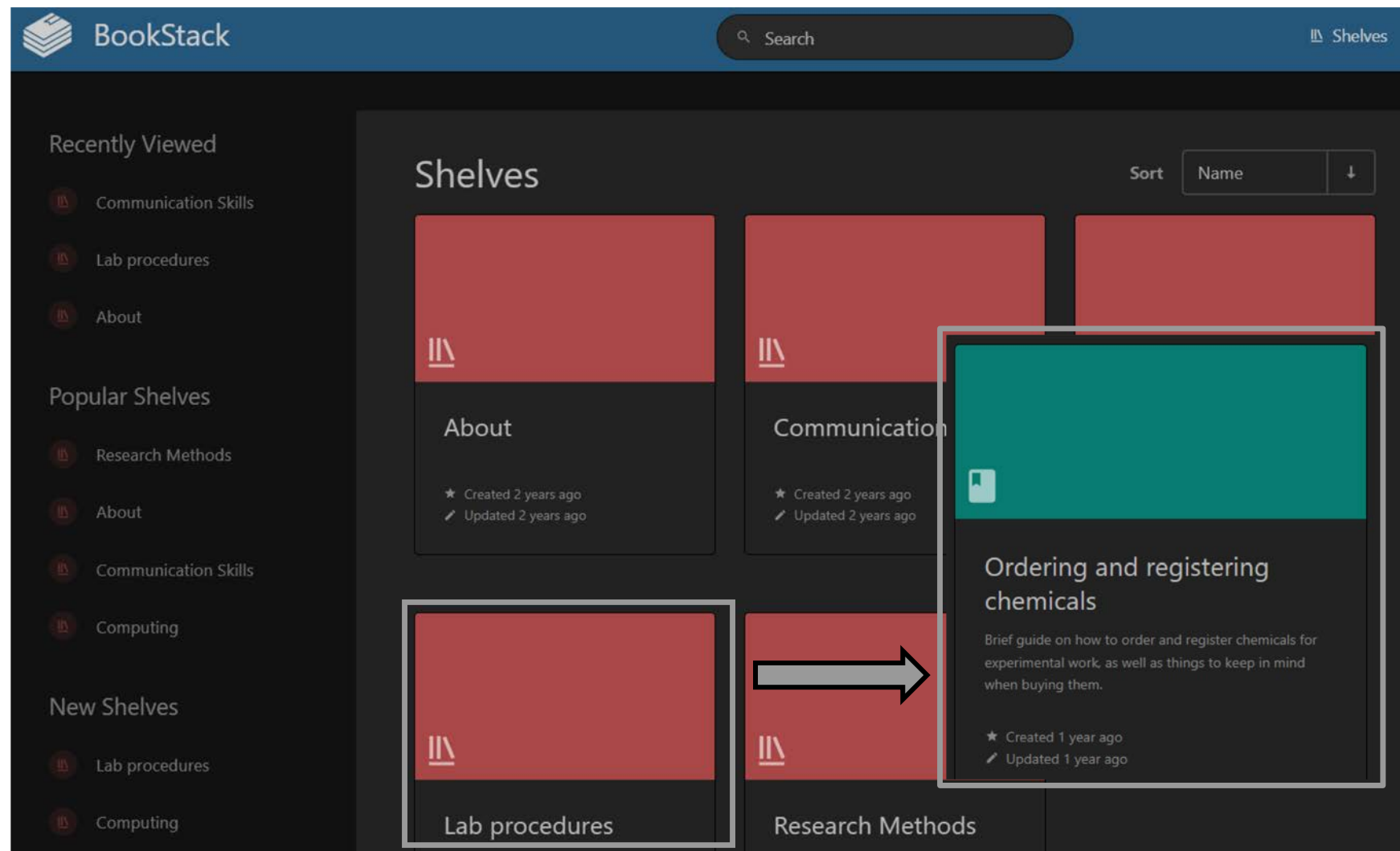
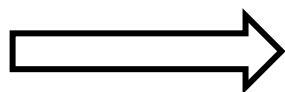
At the bottom, there is a section with two columns: 'Drafts' and 'Final'. The 'Drafts' column shows a card for 'JALT-CALL Paper' with a red notification badge '58'. The 'Final' column shows a card for 'Muhamm...' with a timestamp '12:57pm'. A yellow arrow points from the 'EnergyPolicy' team channel to the 'Drafts' section. A yellow box highlights the 'Paperwork' team channel and the 'Drafts' and 'Final' sections.



# Computer aided lab-based education



# Computer aided lab-based education



The screenshot shows the BookStack application interface. At the top, there is a search bar and a 'Shelves' link. The main content area is divided into several sections:

- Recently Viewed:** A list of shelves including 'Communication Skills', 'Lab procedures', and 'About'.
- Popular Shelves:** A list of shelves including 'Research Methods', 'About', 'Communication Skills', and 'Computing'.
- New Shelves:** A list of shelves including 'Lab procedures' and 'Computing'.
- Shelves Grid:** A grid of shelf cards. The 'About' shelf is highlighted with a red border. The 'Lab procedures' shelf is also highlighted with a red border. An arrow points from the 'Lab procedures' shelf to a detailed view of the 'Ordering and registering chemicals' shelf.

The detailed view of the 'Ordering and registering chemicals' shelf shows a teal header, a book icon, the title 'Ordering and registering chemicals', a brief guide on how to order and register chemicals for experimental work, and metadata: 'Created 1 year ago' and 'Updated 1 year ago'.

# Cross lab seminar



Presentation skill

Speaking skill

Listening skill

Constructive criticism

Critical thinking skill

Engineering thinking skill



# Cross lab students win best presentation awards at campus student workshop (MISW)

Xing  
(2024)



Tony  
(2023)



May 2019

# Cross laboratory



**Thank you!**



HP: <https://www.clab-tokyotech.org/>

FB: <https://www.facebook.com/CrossLaboratoryTokyoTech>

IG: [https://www.instagram.com/cross\\_labs/](https://www.instagram.com/cross_labs/)