Kyoto University's

iCeMS

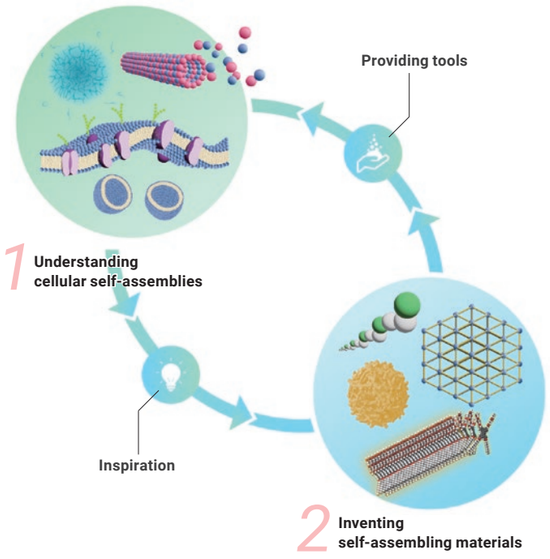
Inspiring Creativity

In the Spirit of Self-Assembly

iCeMS (Institute for Integrated Cell-Material Sciences) is a research institute of **Kyoto University** and a member of the **World Premier International Research Center Initiative (WPI)** — a network of world-class research centers supported by Japan's Ministry of Science.

Our work goes beyond advancing material science and cell biology. We are piloting new approaches such as strengthening global collaboration, developing core facility models, creating research-driven startups, and building an inclusive and diverse research environment.

Key Research Concepts



1 Understanding cellular self-assemblies

Life is the ultimate example of self-assembly. We will lead the way in understanding intracellular self-assembly mechanisms that govern compartmentalization, signal transduction, gene expression, and energy metabolism, as well as in developing the chemical tools that make that understanding possible.

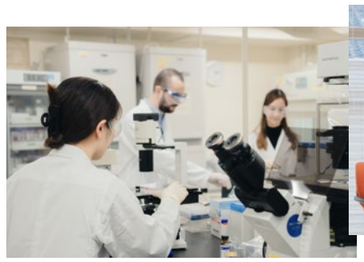
2 Inventing self-assembling materials

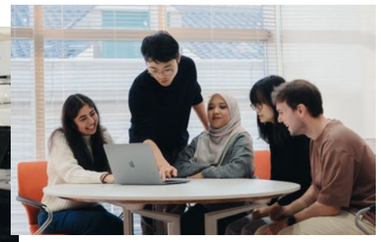
Chemists can find inspiration in intracellular self-assembly. Drawing on that inspiration will lead to the creation of novel functional materials to face the challenge of resolving global problems. Self-assembling pharmaceuticals, self-assembling materials for gas or liquid purification, self-assembling materials for energy storage, and self-assembling materials that chemically convert carbon dioxide are being developed.

We Grow Together

We are committed to fostering open communication among all members, creating a workplace where every individual is respected, and promoting interdisciplinary collaboration.

In addition, iCeMS is home to a highly diverse community of staff, and we implement progressive initiatives to address unconscious bias and enhance diversity & inclusion across the institute.





Find our latest research and career opportunities at

icems.kyoto-u.ac.jp

iCeMS Kyoto Search

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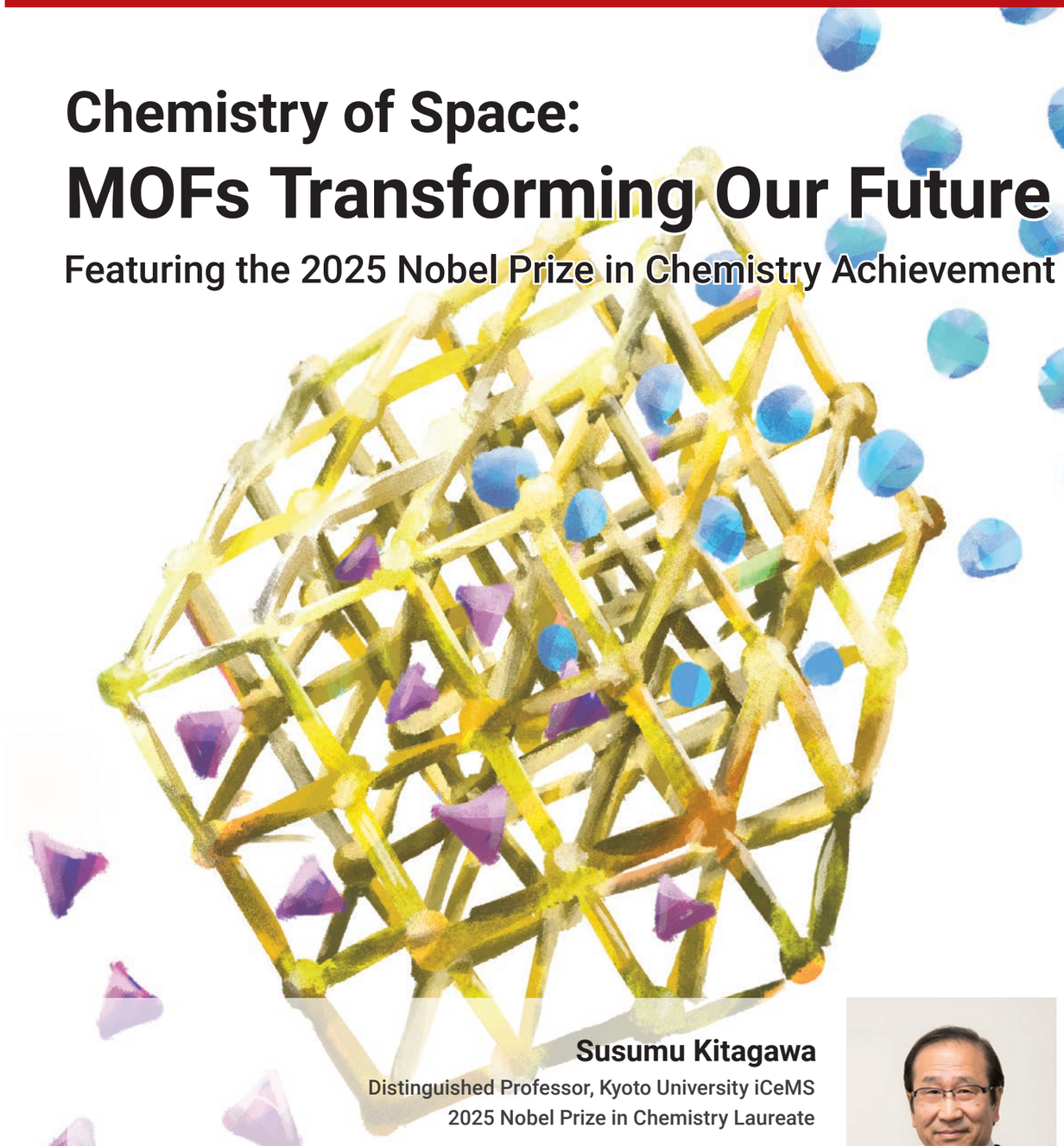
Chemistry of Space:
MOFs Transforming Our Future

Featuring the 2025 Nobel Prize in Chemistry Achievement



Susumu Kitagawa

Distinguished Professor, Kyoto University iCeMS
2025 Nobel Prize in Chemistry Laureate

Professor Kitagawa is the pioneer of porous coordination polymers and MOFs. He contributed significantly to the founding and growth of iCeMS, and continues his research on innovative porous materials.

KUIAS iCeMS KYOTO UNIVERSITY WPI Research Center wpi World Premier International Research Center Initiative

Look inside

"The Chemistry of Space": A Future-Defining Field

What are Metal-Organic Frameworks (MOFs)?

Focusing on the regular pores within crystal structures, iCeMS' Professor Susumu Kitagawa announced the creation of MOFs in 1997. MOFs can capture molecules like methane and oxygen in their nanoscale fine pores. The realization of the world's first stable, functional MOF was the defining achievement that led to his Nobel Prize in Chemistry.

Inspired by Zhuangzi's concept of "The Use of the Useless," Professor Kitagawa's MOF research created a major breakthrough by finding value in "empty space." Today, approximately 100,000 types of MOFs with various functions are being developed worldwide, continually expanding the breadth of research and application.

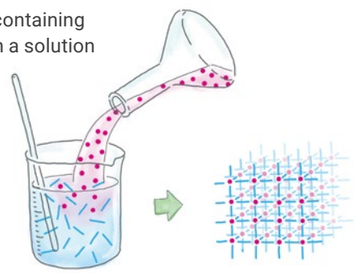
Key Characteristics of MOFs

Immense Surface Area

Enables highly efficient, large-volume molecular adsorption and reaction.

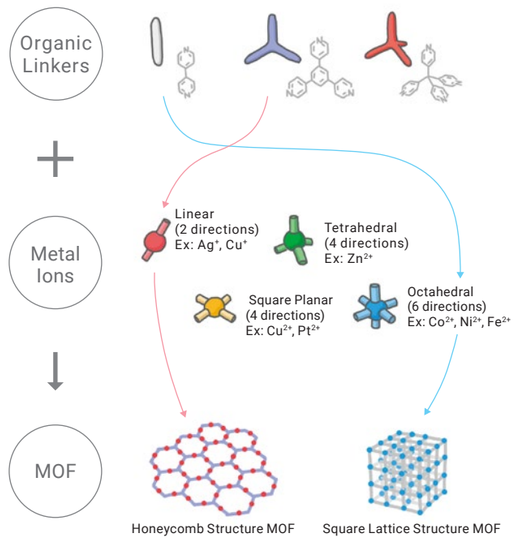
Easily Made

Simply mix a solution containing organic molecules with a solution containing metal ions.



Fully Designable

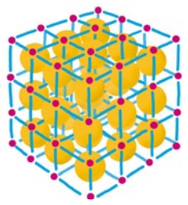
The structure can be freely designed to function against a targeted molecule, offering infinite possibilities.



Applications of MOFs

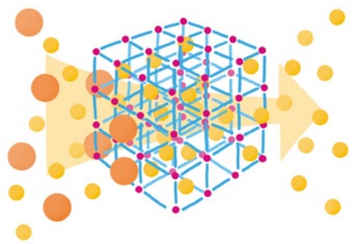
Storage

Safely store gasses like Hydrogen, Methane, and CO_2



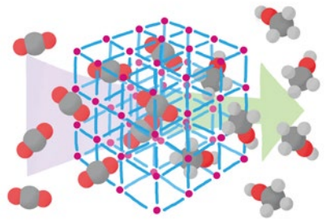
Separation

Adsorb and separate only the target molecule from a mixture



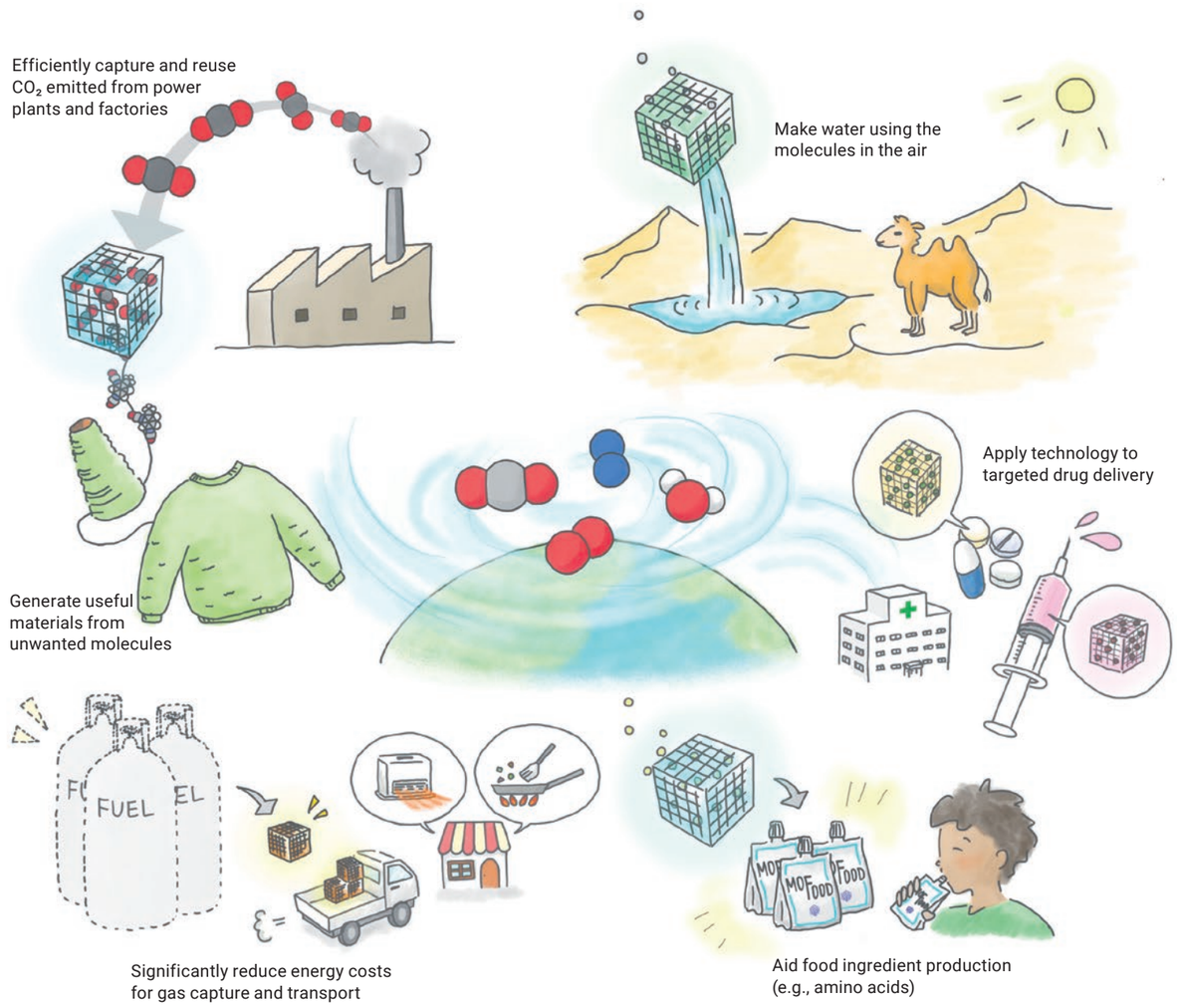
Conversion

Chemically convert adsorbed molecules (eg, CO_2 → Methanol)



Toward a Sustainable, Circular Society

MOFs have the potential to create new systems for cycling resources and energy by capturing, releasing, or converting atmospheric molecules. The utilization and cycling of elements like carbon, nitrogen, oxygen, and hydrogen from the air could fundamentally change how we use resources. By retrieving and reusing unwanted substances like CO_2 directly from the atmosphere, MOFs are positioned to support a sustainable future.



Toward a Conflict-Free World with Equitable Resource Access

Air exists equally across the globe, independent of national borders. If air can be utilized as a resource, we can build a world free from resource conflicts and regional disparities. We can realize a world of equity, regardless of a country's size or resource wealth. This is the future we strive toward with the boundless possibilities of MOFs.