



# 関根 泰

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## Top -level research and data

Realization of a carbon-neutral society by establishing on-site, on-demand chemical processes with distributed energy using unconventional (low-temperature and high-efficiency) catalytic reactions

(Representative papers)

- Quantum Annealing Boosts Prediction of Multimolecular Adsorption on Solid Surfaces Avoiding Combinatorial Explosion  
Hiroshi Sampei, Koki Saegusa, Kenshin Chishima, Takuma Higo, Shu Tanaka, Yoshihiro Yayama, Makoto Nakamura, Koichi Kimura, Yasushi Sekine  
JACS Au
- Key factor for the anti-Arrhenius low-temperature heterogeneous catalysis induced by H<sup>+</sup> migration: H<sup>+</sup> coverage over support,  
Kota Murakami, Yuta Tanaka, Ryuya Sakai, Yudai Hisai, Sasuga Hayashi, Yuta Mizutani, Takuma Higo, Shuhei Ogo, Jeong Gil Seo, Hideaki Tsuneki, Yasushi Sekine\*,  
Chemical Communications, 56, 3365-3368, 2020.
- Electrocatalytic synthesis of ammonia by surface proton hopping,  
R. Manabe, H. Nakatsubo, A. Gondo, K. Murakami, S. Ogo, H. Tsuneki, M. Ikeda, A. Ishikawa, H. Nakai, Y. Sekine\*,  
Chemical Science, 8, 5434 - 5439, 2017.

## Keyword

- Catalyst, catalytic reaction
- Hydrogen production
- Energy carriers
- Electrocatalytic reaction
- Electric field application
- Steam reforming
- Surface protonics
- Protonics
- Low-energy discharge

## Deployment targets (sites, materials, etc.)

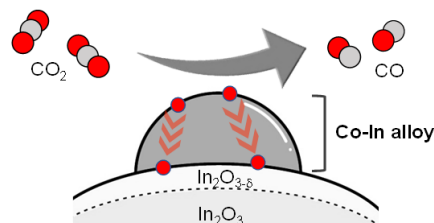
Deployment sites: Automobile manufacturers, catalyst manufacturers, oil companies, etc.

Deployment technologies: catalytic reaction process, hydrogen production, methane conversion, etc.

## Features (implementation means, etc.)

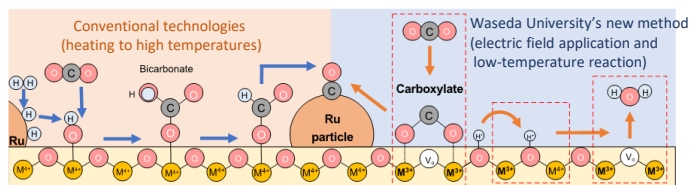
### Development of low-temperature and high-efficiency carbon dioxide recycling process

CO<sub>2</sub> conversion @ 400 – 500°C : **80% or more**  
CO<sub>2</sub> splitting rate @ 500°C : **280.2 μmol min<sup>-1</sup> g<sup>-1</sup>**



Successfully used new materials to react and recycle over 80% of carbon dioxide even at temperatures of 400–500 degrees, which is much lower than before

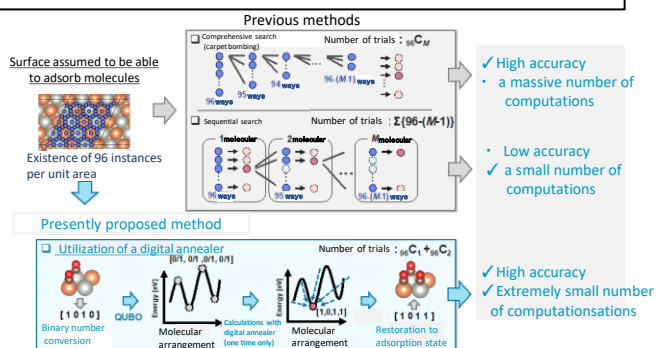
URL: <https://www.waseda.jp/top/news/79080>



Unveiling of a new material and process that enables the chemical conversion of carbon dioxide to carbon monoxide, which conventionally requires temperatures of over 700 degrees, to be achieved at temperatures as low as 100 degrees

URL: <https://www.waseda.jp/top/news/85969>

### Prediction of molecular adsorption on solid surfaces using next-generation computing



- Successfully predicted adsorption of molecules onto solid surfaces for the first time in the world using quantum-inspired technology, which is a next-generation computing technology
- Development of a new method for rapidly searching for adsorption coordination of molecules without causing combinatorial explosion
- Accurate and high-speed prediction of an optimal arrangement for composite materials enabled with many combinations of molecular arrangements

URL: <https://www.waseda.jp/top/news/88967>

## Associated proprietary technologies

- Dehydrogenation catalyst, dehydrogenation catalyst manufacturing method, dehydrogenation reactor, dehydrogenation reactor manufacturing method, hydrogen manufacturing system, and hydrogen manufacturing method
- Carbon monoxide production methods, precursor production methods, and chemical looping system materials

## Expected outcome/ applications

- Realization of chemical processes with a low environmental impact using low temperature and low energy input
- Realization of a carbon-neutral society by establishing on-site and on-demand chemical processes with distributed energy using unconventional (low-temperature and high-efficiency) catalytic reactions

## Associated SDGs

