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RESEARCH & COLLABORATION PROFILE

KEY WORDS: Heterogeneous Catalysis, Reaction engineering, C1 Gas Valorization, Zeolite, Metal oxide



Research Snapshot. Dr. Kwon develops heterogeneous catalytic systems for the conversion of small molecules into value-added chemicals and hydrocarbons. His research focuses on methane activation, chloromethane conversion, and CO_2 utilization through the design of zeolite-based and metal oxide catalysts. His recent work combines catalyst structure and surface chemistry control, reaction pathway investigation, and mechanistic analysis to improve catalytic activity and product selectivity.

RESEARCH EXPERTISE

- **Zeolite catalyst design & synthesis**: Structural and chemical modification of zeolite catalysts to control catalytic activity, reaction pathways, and product selectivity.
- **Metal oxide catalyst**: Design and application of metal oxide and carbonate catalysts for selective chemical transformations through surface reaction and sequential activation strategies.
- **Catalyst characterization**: Investigation of catalyst structure, surface properties, acidity, and metal distribution using spectroscopic, microscopic, and temperature-programmed techniques.
- **C1 gas valorization reaction**: Development of heterogeneous catalytic systems for the activation and selective conversion of small molecules into value-added chemicals and hydrocarbons.
- **Reaction mechanism and kinetic analysis**: Investigation of reaction pathways, catalytic intermediates, and structure–performance relationships to understand catalytic behavior and product formation.

RECENT RESEARCH HIGHLIGHTS

- **Carbonate-mediated CH_4 & CO_2 conversion**: Developed sequential activation strategies using metal carbonate-based catalysts to produce oxygenated chemicals, including acetic acid and methanol **(Appl. Catal. B 2023, 2024 / J. CO2 Util. 2026 / Chem. Eng. J. 2026*)**.
- **Zeolite-controlled CH_3Cl conversion**: Evaluated the effects of zeolite topology, pore dimensionality, and spatially controlled MgO modification on CH3Cl conversion and light olefin production **(Chem. Eng. J. 2023 / J. Catal. 2026 / Adv. Sci. 2026*)**. (*under revision)

POTENTIAL COLLABORATION RESEARCH

Best-fit collaborator areas: reaction development & catalysis | photochemistry & electrochemistry | enzyme | environments

- **1. Development of new catalysis:** co-discovery of unconventional reaction and catalysts.
- **2. Beyond thermal catalysis**: expansion of activation methods and fundamental understandings of their catalytic behaviors.
- **3. Enzyme as a catalyst**: collaborative study of enzyme-based catalysis.
- **4. Environmental chemistry:** material designs and its applications in pollutants removal, conversion, and separation.

SELECTED RECENT PUBLICATIONS

- **Journal of Catalysis 2026, 453, 116464 —** MgO-driven CH_3Cl spillover for enhanced light olefin production over ZSM-5 zeolite.
- **Catalysis Today 2026, 462, 115548 —** Perovskite-supported Pt catalysts for selective ethylene glycol oxidation.
- **Appl. Catal. B 2024, 357, 124304 —** Sequential CO_2/CH_4 activation over silica-encapsulated Co_3O_4 nanoparticles.
- **Appl. Catal. B 2023, 339, 123120 —** Carbon-consuming cycle for acetic acid production via sequential CO_2/CH_4 activation.
- **Chem. Eng. J. 2023, 474, 145851 —** SnO_2-modified SSZ-13 zeolites for selective chloromethane-to-olefin conversion.

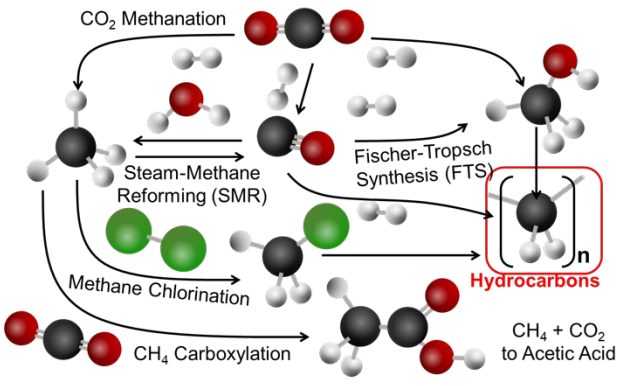
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https://nanocatalystlab.wixsite.com/nanocatalystlab

REPRESENTATIVE RESEARCH FIGURES / SCHEMES

C1 gas valorization reaction



Catalytic material development

