



UNIVERSITY OF DELAWARE
DELAWARE ENERGY
INSTITUTE

DEI SEMINAR

MONDAY

JUNE 26, 2023

10:00 AM

467 ISE LAB



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UNIVERSITY OF TOKYO

BIO

Fuminao Kishimoto is an Assistant Professor in the Department of Chemical System Engineering at the University of Tokyo. He received a PhD degree from Tokyo Institute of Technology in 2018 under the supervision of Professor Yuji Wada. During 2018–2020, he worked at the University of Tokyo as a Japan Society for the Promotion of Science (JSPS) Postdoctoral Fellow (SPD) in the group of Professor Tatsuya Okubo and Professor Toru Wakihara. He was selected as Leading Initiative for Excellent Young Researchers (LEADER) by MEXT and Excellent Young Researcher by The University of Tokyo before moving to his current position in 2021.

ATOMIC SCALE MICROWAVE SELECTIVE HEATING OF SINGLE METAL CATIONS IN ZEOLITES

TALK

Microwave (MW)-driven catalytic systems are attracting attention not only as an aggressive electrification strategy of the chemical industry but also as creating a unique catalytic reaction field that conventional equilibrium heating methods cannot achieve. This study proposed and unlocked the direct and selective heating of single alkali metal cations in the pores of aluminosilicate zeolites under MW. Among the alkali cation exchanged FAU zeolites, Cs⁺ exchanged zeolite was efficiently and stably heated by MW due to the large dielectric constant. The MW selective heating of Cs⁺ achieved a selectivity improvement in the catalytic CH₄ combustion reaction at Cs⁺ sites by suppressing gas-phase CH₄ radical propagation. The Cs–O pair distribution function revealed by synchrotron-based in situ high-energy X-ray total scattering measurements gave us direct evidence of peculiar displacement induced by the MW selective heating on the Cs⁺ cation, which was consistent with the results of molecular dynamics (MD) simulation mimicking MW heating. This study provides experimental evidence of local heating effects occurring at the atomic level, beyond the nanoscale MW local heating effects that have been discussed in composite material systems. Understanding the local heating field on the atomic scale will provide a direction for a precise mechanistic understanding of the ambiguous term microwave “non-thermal” effects. These findings are expected to lead to energy-saving catalytic systems that can be realized by concentrating diffusive thermal energy locally.

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