The CATALYSIS SOCIETY of Metropolitan New York
www.nycsweb.org

Chair
Jihad Dakka
Jdakka48@gmail.com

Treasurer
John Brody
John.F.Brody@Exxonmobil.com

Student Representative
Samuel Moore
scmoore@princeton.edu

Wednesday, January 17th, 2024
Princeton University, Time TBA

Prof. Viktor Cybulskis

Biomedical and Chemical Engineering Department
Syracuse University
vjcybuls@syr.edu

High-Silica Pd-Based Zeolite Catalysts for Lean-burn Natural Gas Emissions Control

Large natural gas engines, such as those used for power generation and maritime transportation, generate less CO_2 than coal or petroleum but the global warming impact of uncombusted methane (CH_4) emitted in the exhaust far exceeds CO_2 and must be abated by using catalytic aftertreatment devices. Although metal oxide-supported Pd catalysts are active for CH_4 oxidation, they require temperatures above 500 ºC and high Pd loadings to convert CH_4 in the presence of combustion products such as H_2O, CO_2, SO_2. Such demanding operating conditions lead to fast and irreversible catalyst deactivation, hindering widespread commercial implementation. Zeolites are promising support materials to overcome these challenges due to their hydrothermal stability, resistance to dealumination in the presence of steam, and unique ability to confine active metals to prevent thermal sintering. Our recent work demonstrates that small- and medium-pore zeolites, such as CHA and MFI, respectively, with very high Si/Al ratios (50-∞) can stabilize reactive Pd

nanoparticles, either through encapsulation or metal-support anchoring, and increase CH_4 oxidation rates at low temperatures in the presence of H_2O. CH_4 oxidation performance after simulated aging at 650 ºC for 1 h under wet-lean conditions (0.15% CH_4, 5% O_2, 5% H_2O, bal. Ar) reveals that 1 wt.% Pd/CHA catalysts with Si/Al > 33 attain > 90% CH_4 at temperatures below 400 ºC compared to 500 ºC for a conventional 1 wt.% Pd/Al_2O_3 catalyst. Furthermore, steady state CH_4 turnover frequencies over Pd-based CHA and MFI catalysts are up to 4× greater than 1 wt.% Pd/Al_2O_3, suggest that these high-silica zeolites contain Pd sites that more easily activate CH_4 by inhibiting the accumulation of inactive hydroxyl species on the Pd surface in the presence of H_2O while facilitating O_2 adsorption and transport to oxidize adsorbed CH_4. Increasing the zeolite Si/Al ratio leads to greater hydrophobicity and improved catalyst durability in presence of H_2O during CH_4 oxidation under lean-burn conditions by decreasing the mobility of active Pd species and reducing the inhibiting effect of H_2O on catalytic turnovers.

Speaker Bio

Viktor J. Cybulskis is an Assistant Professor in the Department of Biomedical and Chemical Engineering at Syracuse University. He received his B.S. in Chemical Engineering from Purdue University in 2005. He began an industrial career with LyondellBasell Industries, holding various roles in manufacturing and research and development for fuels and petrochemicals, and then joined TPC Group in 2009. He returned to Purdue University and received his Ph.D. in 2016 under the direction of Fabio H. Ribeiro and W. Nicholas Delgass. He was a postdoctoral scholar at the California Institute of Technology with Mark E. Davis. In August 2018, he joined the faculty at Syracuse University. His research focuses on understanding the molecular details of heterogeneously catalyzed reactions and designing reactive micro-environments to enable new pathways for selective chemical transformations. He received the ACS PRF Doctoral New Investigator Award (2022) and was selected as a finalist for the Beckman Young Investigator Award (2023). He is a licensed professional engineer, currently serves as Secretary of AIChE's Licensing and Professional Development Committee, and is regularly involved in session organization and chairing at national meetings for AIChE, ACS, and NAM. In his free time, he enjoys the outdoors, reading, watching sports, and spending time with his family.

Schedule TBA

Meeting Fees	
Professional Members	$40
Non-members	$50
Students	$25 (Student Members = $10)
Retired/Post-Doc/Unemp.	$40 (Members = $30)
Annual Membership Dues	***$35 (Students = $15)***

Deadline for reservations is **12:00PM Wednesday, January 10th, 2024**

Please RSVP online using the online form.

To renew your membership, please visit this link.