Faculty of Engineering and Applied Science
Chemical Engineering Seminar Series

Small Molecules – Big Challenges: Can We Develop an Economically Viable Process for Converting CO2 to Renewable Synthetic Fuels?

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Virtual

Thermocatalytic conversion of CO_2-rich streams (e.g., landfill gas, biogas, industrial flue gases) into synthetic fuels is an attractive route for CO_2 utilization. This approach of Carbon Capture & Utilization (CCU) is an alternative to Carbon Capture & Storage (CCS) by storing CO_2 in geological formations and other similar routes. To make the process of thermocatalytic conversion sustainable, H_2 (required for CO_2 hydrogenation to fuels) should have negligible carbon footprint, which is achievable if H_2 is produced via water electrolysis using renewable (or nuclear) power. However, a number of technological issues remain to be resolved with respect to the design of the CO_2 hydrogenation process. These issues are mainly related to catalyst performance, reactor design, and system integration.

This talk presents recent advances achieved in our group with respect to the thermocatalytic conversion of CO_2 into renewable natural gas (RNG) and renewable synthetic gas (RSG). Novel catalytic formulations developed in our group, based on emerging catalytic materials and advanced synthesis techniques, show promising catalytic performance. Possible mechanisms of superior catalytic activity and selectivity are discussed. Novel reactor configurations are being developed, focusing on thermal management and performance optimization. Results of numerical simulations and experimental proof-of-concept experiments are presented. Techno-Economic Assessment for a particular case of converting landfill gas to RNG is discussed. Altogether, our recent developments provide a new avenue for CO_2 utilization into useful fuels.