Novel catalyst for low-temperature CO₂ hydrogenation to methanol

The utilization of CO₂ as C1 source is a promising strategy to produce fuel and chemical given the limited CO₂ budget and the increasing role of renewable energy in the future. Among all the possible products from CO₂ reduction, methanol is of especial interest since it is one of the most important platform chemicals in current chemical industry and it is also a liquid fuel with high volumetric and gravimetric energy density. Nowadays, methanol is commercially produced from syngas (CO and H₂) using Cu-ZnO composite catalyst. However, such methanol catalyst does not exhibit sufficient activity and stability if switching feedstock from CO to CO₂.

The main objective of the project is to develop novel heterogeneous catalysts for reduction of CO₂ with H₂ at low temperature (< 200 °C) in order to increase the equilibrium reaction conversion. Specifically, two promising catalyst systems are chosen for further investigation at early stage of the project based on recent experimental and theoretical study in literature: (1) CeO₂ supported catalyst and (2) metal carbide based catalyst. For catalyst testing, two different test modes will be employed: one is gas phase reaction using fixed-bed reactor and another one is liquid phase reaction using batch reactor. Being part of the project, you are able to learn how to conduct heterogeneous catalyst research systematically starting from catalyst preparation to final catalyst test; meanwhile you will also be familiar with number of modern characterization techniques including, but not limited to, XRD, XPS, N₂ physisorption, TEM and Raman.

Possible projects:
- Tune oxygen vacancy property of CeO₂ by doping transitional metal and investigate the effect of doping on catalytic CO₂ hydrogenation.
- Synthesize highly dispersed Mo₂C catalyst via solid-solid carburization approach using carbon support and study its CO₂ catalytic hydrogenation performance.
- Your initiative is highly appreciated and ask for up-to-date information

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Reference: