

Chemical Engineering Approaches for Catalytic Reduction of CO₂

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Converting CO₂ to value-added chemicals and fuels is one of the most practical routes for reducing CO₂ emissions while fossil fuels continue to dominate the energy sector. In this talk we will present several routes in catalytic CO₂ conversion: (1) CO₂ hydrogenation by thermocatalysis, (2) CO₂ reduction by electrocatalysis, and (3) simultaneous upgrading of CO₂ and shale gas. We will use these examples to highlight the importance of combining kinetic studies, *in situ* characterization and density functional theory calculations for the mechanistic understanding of CO₂ conversion. We will use the hydrogenation of CO₂ to methanol as an example to illustrate the challenges in achieving a net-reduction of CO₂ by performing mass and energy balance analysis. We will also demonstrate proof-of-principle results of several promising catalytic reactions in simultaneously converting CO₂ and light alkanes to syngas, olefins, aromatics and oxygenates.