Shale Gas Innovation Workshop

Wet Gas in the Marcellus Shale: An Opportunity to Revisit Direct Catalytic Routes from Ethane to Ethylene

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Ethylene is produced from ethane via a complex series of reactions between ethane and steam in a cracker. A cracker operates at temperatures of ~850°C with a residence time on the order of a few milliseconds in order to minimize further reaction of ethylene (primarily to coke or solid carbon). Although crackers work with sufficient yield, they have a large energy footprint, and require significant quantities of water. Previous research efforts have investigated direct catalytic routes to ethylene from ethane. Due to favorable thermodynamics, oxidative dehydrogenation (ODH) is an appealing route if selectivity to ethylene can be favored over complete combustion. The most promising catalysts are early transition metal oxides, such as VO_x and MoO_x. However, research efforts with these materials have all but been abandoned even though they demonstrate high selectivity at low yield. New synthetic routes provide the opportunity to synthesize more complex early transition metal catalyst that may have enhanced activity and selectivity for the ODH of ethane. The discovery of Marcellus Shale should be used to re-initiate fundamental and applied research in catalytic dehydrogenation of ethane to ethylene.

My group in the Department of Chemical Engineering at Penn State is primarily interested in fundamental catalysis studies, with an emphasis placed on combined synthesis, characterization and reactivity studies. In particular, we develop organometallic and heterogeneous catalysis for small molecule conversion, including alkyne/alkene functionalization and biomass upgrading. Additional efforts employ electron and photon-based probes to understanding the structure of catalysts while in action.