Modular Manufacturing for Emerging Energy Industries: Green Ammonia, Shale Gas, and Biomass Upgrade

Dion Vlachos

Department of Chemical and Biomolecular Engineering, Catalysis Center for Energy Innovation, Delaware Energy Institute, University of Delaware, Newark, DE 19716-3110

vlachos@udel.edu; Tel. (302)-831-2830; Fax (302)-831-1048

ABSTRACT

There is renewed interest in the chemistry and processing of small molecules, such as carbon dioxide, CO_2, ammonia, NH_3, and small hydrocarbons (methane, ethane and propane). The large energy demand and associated large production of CO_2 in ammonia production, the conversion of CO_2 to chemicals and fuels, and the revolution of shale gas in the U.S., and thus of small hydrocarbons, are changing the global energy and chemicals terrain and are creating new opportunities for research and manufacturing. Common to the small molecules are the challenges of activating chemical bonds, the large energy demand, the equilibrium limitations, the loss of selectivity, and catalyst deactivation. At the other extreme, biomass is the only sustainable source of carbon for renewable fuels and chemicals but this feedstock is inherently very complex. In addition, processing some of these resources may require distributed manufacturing, whose economic viability is uncertain. These challenges require understanding of the fundamental chemistry and development of new catalysts and processes. This talk will overview these emerging trends and present examples from biomass and small molecule activation, and outline future research directions in process and catalyst intensification.