Chemical Engineering Colloquium

January 28, 2026

Goddard Hall, Room 227

12:00 PM – 1:00 PM

Controlling Selective Alkane Oxidation Cascades for Sustainable Chemical Production

Professor Prashant Deshlahra,

Tufts University

Small olefins such as ethylene and propylene are among the most important building blocks of the chemical industry. These olefins are produced by cracking and dehydrogenating alkanes in endothermic reactions that require large centralized chemical processes to be efficient. Subsequent stepwise conversion of olefins to more valuable oxygen containing organic molecules often requires different catalysts and product separations in each oxidation step. Each of these processes seek to improve efficiency for specific steps by minimizing carbon loss in the form of coke or CO_2. An alternative approach can involve the use of multifunctional catalysts that directly convert alkanes to valuable oxygenates performing multiple steps in one reactor, avoiding energy intensive endothermic reactions and product separation. Such approaches can allow modular processes for energy-efficient distributed manufacturing of high-value chemicals. This talk will focus on our research efforts to identify what catalyst properties are required to enhance selectivity for such multistep cascade reactions. Specifically, we will discuss how (i) mixed metal oxides that offer confinement of molecules in pores and optimal acid and redox strengths can selectively oxidize alkanes to carboxylic acids (e.g., acetic and acrylic acid), (ii) new bimetallic catalysts can selectively couple alkenes and carboxylic acids to form unsaturated esters (e.g., vinyl acetate). Perspectives on how these two disparate types of catalysts may be able to operate in tandem to go from alkanes to unsaturated esters in the same process will also be discussed.

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