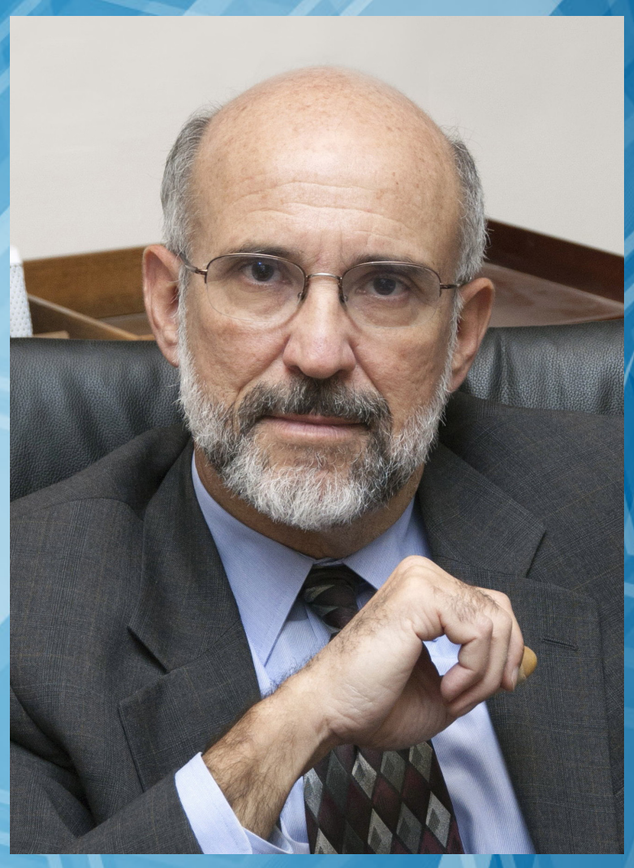
2016 DISTINGUISHED SEMINAR SERIES

DEPARTMENT OF CHEMICAL AND ENVIRONMENTAL ENGINEERING

THE CHEMISTRY AND ENGINEERING OF C_1 MOLECULES: METHANE CONVERSION AND BEYOND



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The recurring need for advantaged feedstocks as precursors to chemicals and fuels brings us once again to scientific and engineering matters pertaining to the conversion of molecules without any C-C bonds, such as methane, methanol, and dimethyl ether. Such C1 molecules, especially methane, present thermodynamic and kinetic challenges that bring significant complexity and costs into their chemical transformations. We gather here some unifying concepts and, in doing so, provide guidance about the most attractive C1 conversion strategies. These concepts include (i) thermodynamic constraints and the limitations of catalysis in circumventing them; (ii) the preeminence of process simplicity and inexpensive oxidants over the allure of direct conversions; (iii) the enduring and practical principles of kinetic and thermodynamic protection (iv) the coupling of separations with reactions and of multiple catalytic functions; (v) the prevalence of kinetic bottlenecks in forming the first C-C bond; and (vi) the emergence of a C2 conversion platform as we overcome (or accept) the limits of C1 chemistries. The conclusions are sobering, as the magnitude of the challenge so warrants.

ENRIQUE IGLESIA is the Theodore Vermeulen Chair in Chemical Engineering at the University of California at Berkeley, a Faculty Senior Scientist at the Lawrence Berkeley National Laboratory, and the Director of the Berkeley Catalysis Laboratory. He received a B.S. from Princeton University and a Ph.D. degree from Stanford University in chemical engineering. He joined UC-Berkeley in 1993 after 12 years as a research scientist and manager at the Exxon Corporate Research Labs. He has served as Editor-in-Chief of Journal of Catalysis (1997–2010) and as President of the North American Catalysis Society since 2008. He has been elected to the National Academy of Engineering (2008) and the American Academy of Arts and Sciences (2015) and is a Fellow of the American Chemical Society and the American Institute of Chemical Engineers, and an Honorary Fellow of the Chinese Chemical Society.

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