

Nuclear Engineering Seminar

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Low temperature plasmas for sustainable synthesis of chemicals

Abstract

Ionized gases or plasmas could play an integral part in our future energy economy. High temperature plasmas are being studied for fusion reactors that in the future could provide a clean (carbon-free) form of electricity. But the electricity is only a source, and must be used downstream for various applications. Many current applications are not powered by electricity. For example, most chemical manufacturing is carried out by heat-driven processes where the heat is derived by burning fossil fuels which then generates greenhouse gas emissions. Many of the feedstocks are also not sustainable. Low temperature plasmas can address these issues as they are powered by electricity which in the future could come from renewable sources such as fusion (or solar, wind, etc.), and the reactive potential of chemical species generated enables activation of a wide-range of potential feedstocks.

Our research is interested in developing low temperature plasmas as one of the solutions to decarbonizing and decentralizing the chemical industry to reduce our carbon footprint and enable distributed and on-demand production. In this talk, I will discuss two examples. One is the synthesis of nitrogen products such as ammonia from air and water. Two is organic chemical synthesis in which a carbon-carbon bond is formed. In both cases, catalysts are avoided which could also create waste or be costly. Scientific issues such as the reaction selectivity and mass transport limitations will be discussed.



R. Mohan Sankaran received his B.S. in Chemical Engineering from the University of California Los Angeles in 1998 and his Ph.D. in Chemical Engineering from the California Institute of Technology. He began his independent academic career in the Department of Chemical and Biomolecular Engineering at Case Western Reserve University as an Assistant Professor in 2005, was promoted to Associate Professor in 2010, then promoted to Professor in 2014. In 2020, he moved to the Department of Nuclear, Plasma, and Radiological Engineering at the University of Illinois at Urbana-Champaign and is currently the Donald Biggar Willet Professor in Engineering. His research program focuses on developing atmospheric-pressure plasmas as a chemical platform for the synthesis of novel materials and small molecules with applications in emerging electronics, medicine, and energy conversion. He has co-authored over 100 peer-reviewed journal articles, edited one book, and contributed several book chapters. He has been recognized for his research achievements by the Camille and Henry Dreyfus Teacher-Scholar Award and the AVS Peter Mark Memorial Award. He currently serves as an Associate Editor of the Journal of Vacuum Science and Technology and a member of the Editorial Board of Plasma Chemistry Plasma Processing, Scientific Reports, and Plasma Research Express and the Advisory Board of the Journal of Physics D. He will be the Program Chair for the AVS 68th International Symposium and Exhibition. (LWRS) program.