

THE MATERIALS SCIENCE AND ENGINEERING DEPARTMENT
SPRING COLLOQUIUM SERIES PRESENTS:

Arun Majumdar

Jay Precourt Provostial Chair Professor, Department of Mechanical Engineering and Materials Science & Engineering (courtesy)
Stanford University
Department of Photon Science, SLAC



Chemical Transformations and Photoabsorption Imaging at Nanoscale

A significant fraction of the effort to decarbonize the global economy requires chemical transformations and management of H_2 , H_2O , CH_4 and CO_2 at the Gigaton-scale. The issue of scale demands attention to infrastructure, supply chains and industrial know-how. This context helps guide and focus the science and engineering to adapt those approaches that are known to be scalable, but now for the purpose of chemical transformations of H_2 , H_2O , CH_4 and CO_2 . Based on this philosophy, using a combination of computations and experiments, we have identified a class of ternary metal oxides that have shown significantly higher redox capacity than traditional ones. We have used these oxides to demonstrate chemical looping approaches to reduce H_2O and CO_2 to produce H_2 and CO , and activate CH_4 . Based on the experimental data, techno-economic analysis suggests that these can be cost-competitive at scale, making it promising for industrial viability. We are also developing a catalytic approach for CH_4 pyrolysis to produce H_2 and carbon nanotubes in fluidized bed reactors, and a new method to chemically dislodge the carbon and regenerate the catalysts.

While these chemical transformations occur at the atomic and molecular scales, chemical imaging at these scales have remained a challenge. Our group is using electron microscopy to study individual ions in liquids as well as photoexcitations in solids with nanoscale spatial resolution. This talk will present some new results and offer some thoughts on how to achieve sub-nanometer resolution.

Dr. Arun Majumdar is the Jay Precourt Provostial Chair Professor at Stanford University, a faculty member of the Department of Mechanical Engineering. From 2009 to 2012 Dr. Majumdar served as the Founding Director of ARPA-E and from March 2011 to June 2012 as the Acting Under Secretary of Energy. After leaving Washington, Dr. Majumdar was the VP for Energy at Google. Dr. Majumdar is a member of the National Academy of Sciences, National Academy of Engineering and the American Academy of Arts and Sciences. He also served as the Vice Chairman of the Advisory Board to the US Secretary of Energy, Dr. Ernest Moniz, was a Science Envoy for the US Department of State, and serves on the advisory board of numerous energy businesses and non-profits.

Tuesday, May 11 • 5 PM CT • Zoom

[Registration is required. RSVP link.](#)

Questions? Contact Kristina.lugo@northwestern.edu.