

KARTHISH MANTHIRAM

Professor
Chemistry and Chemical Engineering
California Institute of Technology

**"Electrification and
Decarbonization
of Chemical Synthesis"**

Wednesday
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3:30 PM

Wu and Chen Auditorium
Levine Hall

ABSTRACT

Chemical synthesis is responsible for significant emissions of carbon dioxide worldwide. These emissions arise not only due to the energy requirements of chemical synthesis, but since hydrocarbon feedstocks can be overoxidized or used as hydrogen sources. Using renewable electricity to drive chemical synthesis may provide a route to overcoming these challenges, enabling synthetic routes which operate at benign conditions and utilize sustainable inputs. We are developing an electrosynthetic toolkit in which distributed feedstocks, including carbon dioxide, dinitrogen, water, and renewable electricity, can be converted into diverse fuels, chemicals, and materials.

In this presentation, we will first share recent advances made in our laboratory on nitrogen fixation to synthesize ammonia at ambient conditions. Specifically, our lab has investigated a continuous lithium-mediated approach to ammonia synthesis and understood the reaction network that controls selectivity. We have developed non-aqueous gas-diffusion electrodes which lead to high rates of ammonia synthesis at ambient conditions. Then, we will discuss how water can be used as a sustainable oxygen-atom source and how carbon dioxide can be used to achieve carbon chain extension. These findings will be discussed in the context of a broader range of electrosynthetic transformations which could lead to local and on-demand production of critical chemicals and materials.

BIO

Karthish Manthiram is a Professor of Chemistry and Chemical Engineering at Caltech. The Manthiram Lab is focused on the molecular engineering of electrocatalysts for the synthesis of organic molecules, including pharmaceuticals, fuels, and commodity chemicals, using renewable feedstocks. Karthish received his bachelor's degree in Chemical Engineering from Stanford University in 2010 and his Ph.D. in Chemical Engineering from UC Berkeley in 2015. After a one-year postdoc at the California Institute of Technology, he joined MIT as an Assistant Professor in 2017. In 2021, he moved to Caltech as a Full Professor of Chemistry and Chemical Engineering. Karthish's research has been recognized with several awards, including the DOE Early Career Award, NSF CAREER Award, Sloan Research Fellowship, 3M Nontenured Faculty Award, American Institute of Chemical Engineers 35 Under 35, American Chemical Society PRF New Investigator Award, Dan Cubicciotti Award of the Electrochemical Society, and Forbes 30 Under 30 in Science. Karthish's teaching has been recognized with the Camille Dreyfus Teacher-Scholar Award, C. Michael Mohr Outstanding Undergraduate Teaching Award, the MIT Chemical Engineering Outstanding Graduate Teaching Award, and the MIT Teaching with Digital Technology Award. He serves on the Early Career Advisory Board for ACS Catalysis and on the Advisory Board for Trends in Chemistry