UCMERCED UNIVERSITY OF CALIFORNIA Graduate MECHANICAL ENGINEERING

Fall 2021 Graduate Seminar

Chemical Looping Combustion for Carbon Capture

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Abstract

Despite the growing trend of renewable energy sources, fossil fuels are still expected to account for 78% of the total energy use of the world in 2040. However, extensive use of combustion processes is the primary source of carbon dioxide (CO_2) emission, which is a major anthropogenic greenhouse gas. Accumulation of the anthropogenic greenhouse gases in the atmosphere is the most likely reason of global warming and climate change. Chemical looping combustion (CLC) is a promising technology to capture the anthropogenic CO_2 from flue gas without the need of a gas separation process. The technology involves indirect combustion of fuel via a metal oxide, commonly known as an oxygen carrier, which transfers oxygen from air to fuel. For solid fuel combustion, a slight variation of CLC, typically known as chemical looping combustion with oxygen uncoupling (CLOU) is preferred. In CLOU, the oxygen carrier materials possess the ability to release gaseous O_2 at suitable temperatures and oxygen partial pressures, unlike the CLC where the fuel reacts with the solid metal oxide to access the lattice oxygen. The kinetically favoured gas-solid reaction makes CLOU more effective than CLC for solid fuels like coal and biomass. Different oxygen carriers containing Cu or Mn oxides have demonstrated high fuel combustion efficiency in CLOU technology. Bi-metallic Cu-Mn oxide is such an oxygen carrier, combining the advantages of its constituting oxides. It has been tested in CLOU reactors for both solid and gaseous fuels and shown promising fuel reactivity and physical stability. In this talk, an overview of the chemical looping combustion process will be provided and reactivity of the bi-metallic Cu-Mn oxide and how it is influenced by different fluidization environments and the impurities in the flue gas, such as sulfur dioxide, will be discussed.

Biography

Dr. Bihter Padak is an Assistant Professor in the Department of Mechanical and Aerospace Engineering at University of California, Irvine and the Associate Director of the UCI Combustion Laboratory. Her research focuses on combustion and emission control technologies, and aims to reduce the environmental impacts of combustion processes. She earned her PhD degree in Energy Resources Engineering at Stanford University. She received her MS degree from Worcester Polytechnic Institute and Bachelor's degree from Istanbul Technical University in Chemical Engineering. She is the recipient of the American Institute of Chemical Engineers' (AIChE) 35Under35 Award in the Energy area for her contributions to the Institute and the chemical engineering profession.

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