DEPARTMENT OF MECHANICAL ENGINEERING
WILLIAM MAXWELL REED SEMINAR SERIES

"Process Research for Direct Air Capture and Li-Ion Battery Recycling."

Xin Gao, PhD.
Power Generation Group of UK CAER

September 24, 2021

Presentation Abstract

The presenter from the Power Generation Group of UK CAER will introduce two recent patent-pending processes for (1) capturing CO_2 from the atmosphere, and (2) recovering valuable metals from the end-of-life Li-ion batteries.

1. Direct Air Capture

The goal of the Paris Climate Agreement is to limit the increase in the global average temperature to 2 °C above pre-industrial levels in this century. To meet this requirement, capturing CO_2 is becoming essential for (1) point sources, including fossil fuel power generation plants, oil refineries, cement and steel manufacturers, and (2) from an open source like air. A common CO_2 capture technology employs a two-reactor process, where organic amines capture CO_2 in an absorber followed by the liberation of the captured CO_2 and regeneration of the capture solvent at an elevated temperature in a stripper. While such methodology is adequate for coal-fired post-combustion capture (13-15% CO_2), the low concentration of CO_2 for other sources, *e.g.*,~400 ppm direct air capture (DAC), complicates the capture process with the implication that new approaches are required for low concentration capture. In this presentation, UK CAER explores an alternative approach assisted mainly by an electrochemical flow cell, which leverages pH swings resulting from water electrolysis to recondition hydroxide-based facile carbon capture solvents in a membrane-electrochemical carbon capture system for low concentration CO_2.

2. Li-Ion Battery Recycling

According to the global electric vehicles (EVs) outlook 2020 from the International Energy Agency, 2.1 million EVs have been sold globally in 2019 with the total stock of 7.2 million EVs, and the year-to-year increase in EV registration is approximately 40%. (Ref) Furthermore, most utilities are on the path to achieve carbon neutral by expanding renewable power generation coupled with Li-battery energy storage. (Ref) Under such a scenario, by assuming 8-10 years for the average lifespan of Li-ion batteries, recycling of ~200 kilotons of Li-ion batteries globally will be required in 2030. For the sake of sustainability, it is urgent to develop a cost-effective and eco-friendly approach that is ready for commercial application prior to the time frame of 2025-2030 for disposal and recovery of valuable materials such as Co, Ni, and Li. In this presentation, the presenter will introduce a H_2-assisted thermal process to recover valuable metals from EoL Li-ion batteries, completely differing from the common methods using strong acids with reducing agents.

Speaker Bio

Xin Gao is a principal research engineer under the direction of Prof. Kunlei Liu from the Power Generation Group of UK CAER. He enjoys developing novel processes for energy production/storage and environmental applications from his understandings of thermal science, process engineering, and physical electrochemistry. He was the UK OTC SBIR prize winner with Powertech Water in 2018 and 2019 by inventing and commercializing the i-CDI desalination process. He received his Ph.D. in Applied Physics from the University of Limerick in Ireland in 2012, where he learned surface science, electrochemical engineering, battery energy storage, and spectroscopic techniques from Prof. D. Noel Buckley. In his leisure time, he watches UK sports, plays soccer, and he is a fan of Liverpool soccer team.

Date: Friday, September 24, 2021
Time: 3:00 PM EST
Place: Whitehall Classroom Building 114
Contact: Dr. Alexandre Martin 257-4462

Attendance open to all interested persons

College of Engineering

DEPARTMENT OF MECHANICAL ENGINEERING
UNIVERSITY OF KENTUCKY
LEXINGTON, KENTUCKY