הטכניון - מכון טכנולוגי לישראל

TECHNION - ISRAEL INSTITUTE OF TECHNOLOGY

הפקולטה להנדסה כימית
ע"ש וולפסון
The Wolfson Department of Chemical Engineering

Wolfson Department of Chemical Engineering Seminar

Monday, June 15th, 2026 at 13:30

Room 5

Modification and Scale-Up of Graphite Fiber Felt Cathodes for Hydrogen Peroxide Electro-Production and Electro-Fenton process

Abed-Alhakeem Azaiza

PhD final seminar

Advisors: Prof. Raphael Semiat and Slava Freger
Department of Chemical Engineering, Technion-Israel Institute for Technology

Hydrogen peroxide (H_2O_2) is a versatile oxidant widely applied in environmental, chemical, and industrial processes. However, conventional anthraquinone-based production methods are energy-intensive, centralized, and associated with significant environmental and transportation limitations. This study investigated the electrochemical production of H_2O_2 through the two-electron oxygen reduction reaction ($2e^-$ ORR) using graphite fiber felt (GF) cathodes, with emphasis on electrode modification, coupled electrode–reactor scale-up, and electro-Fenton (EF) application for micropollutant degradation. The first stage focused on modifying commercial GF cathodes by room-temperature acidic oxidation to improve surface functionality, wettability, and selectivity toward the $2e^-$ ORR pathway. The relationships between surface chemistry, electrochemical behavior, conductivity, and H_2O_2 production were systematically evaluated using surface and electrochemical characterization techniques. The second stage addressed the coupled scale-up of the GF cathode and electrochemical reactor for continuous H_2O_2 electro-production. The effects of electrode size, current density, residence time, and hydrodynamic conditions on H_2O_2 production and current efficiency were investigated. Emphasis was placed on the interaction between electrode properties and reactor transport phenomena. In the final stage, the electro-generated H_2O_2 was applied in an EF process for carbamazepine degradation. Different reactor flow configurations and operating parameters were evaluated in Na_2SO_4 electrolyte and real municipal secondary effluent. Process performance was evaluated based on both degradation efficiency and energy consumption. Overall, this study provides fundamental and engineering insights into the development and scale-up of GF-based electrochemical systems for H_2O_2 electro-production and EF water treatment.

Refreshments will be served at 13:15