

Joint Seminar

By

Prof. T. Alan Hatton

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***Illuminating CO₂ Capture and Release:
A Photochemical Approach for Carbon Mitigation***



Date: 7 October 2026 (Wednesday)

Time: 3:00 pm – 4:30 pm

Venue: HKICE, 6/F
Mong Man Wai Building
City University of Hong Kong



For abstract, please refer to the attached sheet.

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***~ Limited seating ~
~ First come, first served ~***

Abstract

It is well-recognized that the accumulation of anthropogenic carbon dioxide in the environment is accelerating global climate change with devastating effects on the planet ecosystems. An integrated strategy to mitigate these effects must include the arrest of this CO₂ build-up, which has sparked widespread interest in developing strategies for the reduction of ambient greenhouse gas levels, either through interception at point sources, or directly from the impacted environment. Traditional approaches rely on fossil-fuel derived heat sources to exploit wide thermal swings in sorbent capacity for CO₂ capture and release, while recent electrochemical approaches utilizing renewable energy show promise for isothermal operations for this task. Over the past few years there has been an increase in interest in exploiting a low-temperature photochemical alternative to CO₂ separation, replacing fossil fuel or renewable electricity-derived energy sources with natural light to drive pH swings for the modulation of CO₂ absorption/desorption processes. When CO₂-laden solutions of photoacids are irradiated, the photoacid is elevated to its excited state, releasing protons to reduce the pH and drive off the CO₂. When returned to its ground state in the dark, the photoacid is re-protonated, leading to a sharp increase in pH and elevated capacity for CO₂ absorption.

Although photoacid and photobase systems have shown tantalizing promise for such light-driven CO₂ capture–release behavior, little progress has been made in translating these observations to demonstration of continuous pure-CO₂ generation from dilute feeds. In this presentation, we will discuss the development of enhanced photochemical processes with greatly improved working capacity and demonstrated long-term operational stability. The key to the success of these approaches is the development of photoacids with high pK_a values coupled with acidity matching within an amine–photoacid platform, allowing each photoacid molecule to undergo repeated excited-state proton transfers to facilitate carbamic acid-forming CO₂ capture with efficient release. The evolved CO₂ forms self-generated bubbles in a reduced-pressure continuous flow photoreactor, for easy gas disengagement and recycling of the absorbent. Techno-economic analysis projects favorable separation costs. These results establish a practical foundation for scalable light-driven carbon capture.

Biography



T. Alan Hatton is the Ralph Landau Professor of Chemical Engineering, Post Tenure, at the Massachusetts Institute of Technology. He obtained his BSc(Eng)(Hons) and MSc(Eng) degrees in Chemical Engineering at the University of Natal, Durban, South Africa, and worked at the Council for Scientific and Industrial Research in Pretoria for three years before attending the University of Wisconsin, Madison, to obtain his PhD. For 36 years, he was the Director of the MIT School of Chemical Engineering Practice, a unique 110-year program combining high-level graduate coursework with integrated, team-driven intensive industry projects that develop technical, leadership, and communication skills. He also served as a Co-Director of the MIT Energy Initiative Low Carbon Energy Center on Carbon Capture, Utilization and Storage. He has received the MIT-wide Everett Moore Baker teaching award, was a founding Fellow of the AIMBE, and an Honorary Professorial Fellow at the University of Melbourne, Australia. He has chaired a number of national and international conferences on Colloids and Separation processes. In 2026, he was awarded the NAE Bernard M. Gordon Prize for Innovation in Engineering and Technology Education in recognition of his work with the Practice School program.

Hatton's research, which has resulted in more than 500 publications and 60 patents with over 50,000 citations, has encompassed self-assembly of surfactants and block copolymers, synthesis and functionalization of magnetic nanoparticles, and the exploitation of thermal-, photo- and electro-responsive materials for chemical, environmental and pharmaceutical processing applications. His group has pioneered several electrochemically mediated operations for water treatment and resource recovery, as well as for carbon dioxide removal from point sources, ambient air, and ocean waters. The Hatton laboratory has spun out three start-up companies from MIT: Verdorx (2019) is developing electrochemical swing processes for CO₂ capture from point sources and ambient air; Mantel Capture (2022) is focused on exploiting molten salts for CO₂ capture at the high temperatures at which it is produced in many chemical industries; and Solvanic (2025) exploits electromediated amine regeneration for carbon capture and metals enrichment.