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A Sustainable and Multifunctional Photoelectrochemical System for Water and Wastewater Treatment Towards Carbon Neutrality

by

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Host: Asst. Prof Iris Yu

Date: 19 July 2023, Wednesday
Time: 2 pm – 3 pm
Venue: E1-06-01
National University of Singapore
College of Design and Engineering
3 Engineering Drive 2
Singapore 117578

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Seats are limited. Please register early. All are welcome and admission is free

Abstract

Conventional water and wastewater treatment processes are inefficient in degrading pharmaceuticals and personal care products (PPCPs) and cause high carbon emissions. Herein, a multifunctional photoelectrochemical (PEC) system for coupled the removal of contaminants with H_2 evolution was developed to address the above limitations. As for water treatment, we developed a sulfite-adding PEC system using an optimized $BiVO_4$ photoanode, which can simultaneously promote PPCPs degradation, *E. coli* inactivation, and H_2 evolution (as green energy) via activating sulfite under visible light illumination. Sulfite ions could be activated by holes to produce sulfate radicals for contaminant removal and work as hole scavengers to promote electron separation for H_2 production. Regarding wastewater treatment, we developed a low carbon emission PEC system to treat saline sewage for coupled the removal of organic compounds, ammonia, and bacteria with H_2 generation. A reduced $BiVO_4$ (r-$BiVO_4$) photoanode possessing excellent PEC reactivity achieved by introducing oxygen vacancies and V^{4+} species was synthesized for the PEC system, treating saline sewage to meet the discharge standard in 40 minutes (with a complete removal of PPCP) coupled with significant H_2 production as green energy. The PEC system reduced 93% of carbon emissions compared with conventional wastewater treatment due to the reduced generation of N_2O and CH_4. Chloride ions in saline sewage were activated to produce reactive chlorine species, facilitating contaminant removal and retraining N_2O generation. Overall, the multifunctional PEC systems are promising for water and wastewater treatment toward carbon neutrality because of their high efficiency in contaminant removal and significant H_2 evolution to offset carbon emissions.

Speaker's Biography

Ir Prof Irene M.C. LO is currently a Chair Professor in the Department of Civil and Environmental Engineering at The Hong Kong University of Science and Technology (HKUST). She is an elected Academician of the European Academy of Sciences and Arts (EASA), the first Hong Kong scholar inducted into the EASA. She is an elected Fellow of the Hong Kong Institution of Engineers (FHKIE), and elected Fellow of the American Society of Civil Engineers (FASCE). She was appointed by HKSAR Government as Justices of the Peace (JP) in 2017. She was also Adjunct Professor of Tongji University, Tianjin University, Jilin University and Harbin Institute of Technology in China. She had been Visiting Professor of Technical University of Denmark and the University of Wisconsin at Madison.

She was the recipient of the 2004 ASCE James Croes Medal, the 2007 ASCE Samuel Arnold Greeley Award, the 2008 EWRI Best Practice-Oriented Paper Award, the 2009 ASCE Wesley W Horner Award, and the 2012 ASCE EWRI Best Practice-Oriented Paper Award. In addition, she received the Ministry of Education's 2019 Higher Education Outstanding Scientific Research Output Awards in the Natural Science/Technology Advancement.

Her research interests include Advanced oxidation processes, nanoparticles and nanotechnology for environmental applications, water and wastewater treatment, soil and groundwater remediation, and solid waste treatment and disposal. She was recognized as "Top 2% Scientists in the World" in the environmental science/engineering as reported by the study conducted by Stanford university in 2020.

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