香港科技大學
THE HONG KONG UNIVERSITY OF SCIENCE AND TECHNOLOGY

土木及環境工程學系
DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

SEMINAR

HIGH-VALENT IRON SPECIES (Fe^{IV}, Fe^{V}, Fe^{VI}, AND Fe^{VII}) IN WATER SUSTAINABILITY

Speaker

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Abstract

Society is facing numerous challenges like climate change, water scarcity, vector-borne diseases, microbial pathogens, and antibiotics in water. The solution to such difficulties is in innovative approaches that utilize environmentally friendly earth abundant elements having multiple roles. Iron oxide as green molecule in the plus 6-oxidation state (Ferrate, $Fe^{VI}O_4^{2-}$) has multiple modal actions in oxidizing micropollutants (e.g., antibiotics), in coagulating toxic metals (e.g., arsenic and lead) to achieve water sustainability, and in disinfecting water and surfaces (e.g., Clostridium difficile and Murine Norovirus) to enhance population health care. "Activated Ferrate" (Fe^{V} and Fe^{IV}) are relatively short-lived transients when produced in aqueous solution (e.g., $Fe^{V}O_4^{3-}$, $Fe^{IV}O_4^{4-}$, $Fe^{IV}O_3^{2-}$, and $Fe^{IV}O^{2+}$) and can degrade recalcitrant pollutants and microorganisms in water with high efficiency in seconds, which would otherwise take several minutes or hours by Ferrate without activation. Importantly, high-valent iron species (Fe^{V} and Fe^{IV}) can be generated by activating the low-valent iron and high-valent iron species. Significantly, ions that are present naturally greatly increase the reactivity of Fe^{V} and Fe^{IV} and hence the degradation kinetics and oxidation efficiency of micropollutants in water. Examples of Ferrate in sterilization of vegetables and fruits, and water splitting will be presented. More recently, Fe^{VII} in water has been generated for the first time and the finding of this unusual oxidation sates of iron and it potential water treatment will be given. Recent research on single atom catalysts and metal-organic frameworks in abatement of micropollutants will also be presented.

Biography

Virender K. Sharma received his B.Sc. and M.Sc. from University of Delhi and M.Tech. from Indian Institute of Technology. He obtained his Ph.D. from Rosenstiel School of Marine and Atmospheric Science, University of Miami, Florida. His postdoctoral work was at Brookhaven National Laboratory and the State University of New York, Buffalo, New York.He is currently a Professor in the Department of Chemical, Environmental, and Materials Engineering, University of Miami, Florida, USA. He is also serving as the Director of the MS Program of the department. Dr. Sharma has made seminal contributions in the areas of chemistry and environmental applications of ferrates. Dr. Sharma has also made key contributions in understanding the fate and toxicity of natural nanoparticles in the aquatic environments, resulting in an impact on human and ecological health. His research has expanded to include advanced materials such as metal–organic frameworks, covalent–organic frameworks, and single-atom catalysts, exploring their roles in advanced redox processes to address real-world challenges in water, energy, and food sustainability. Guided by his mission of "Saving Lives—Even One Life," his work bridges fundamental science with impactful global applications. His research has produced more than 480 peer-reviewed publications (journals include Environmental Science & Technology, Water Research, Geochim Cosmochim Acta, Accounts of Chemical Research, and Chemical Society Reviews) with more than 54,000 citations with an h-index of 113 (Source: Google Scholar). Dr. Sharma has also published 60 book chapters, 36 proceedings, and authored and edited eight books. Dr. Sharma has been recognized as Highly Cited Researcher (Top 1 %) by the Clarivate (Web of Science) He also serves as an associate editor and editorial board member for several international journals. Prof. Sharma is a Member of the European Academy of Sciences and Arts (EASA) and Academia Europaea (MAE) as well as a Fellow of the AAAS, ACS, EurASc, and RSC. His distinguished honors include the Humboldt Research Award, the Prince Sultan Bin Abdulaziz International Prize for Water, the Southwest Region ACS Award, the Steven K. Dentel AEESP Award for Global Outreach, and the Bush Excellence Award for International Research.

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