Innovations in Electrochemistry to Revitalize The Rust Belt

Abstract:

Metals and alloys are critical ingredients for infrastructure, transportation, energy and defense applications, yet producing them from ore entails significant environmental impacts and energy consumption. High-volume metals such as steel, aluminum, titanium, and specialty metals like rare-earth metals are all produced using carbothermic reduction – a process in which ore is treated with carbon yielding pure metal while generating CO_2 emissions. Despite the fact that metals production accounts for nearly 10% of global greenhouse gas emissions, the old carbothermic process has essentially remained unaltered. US manufacturing of metals is on the decline, and reliance on foreign-sourced metal is on the rise, creating an urgency to bring back manufacturing without compromising sustainability. In this keynote, I will discuss advances in electrochemistry being pursued at CWRU for re-envisioning metals production with a focus on energy-efficiency and sustainability. High-temperature electrochemistry in molten salts has the potential to enable metals production while completely eliminating CO_2 emissions. Further, novel catalytic electrode materials and electrochemical cell designs reduce energy consumption and lower cost of metal production. These patented technologies are now ready to pave the way for revitalizing metals manufacturing in the rust belt. Recent efforts at initiating tech-transfer to industry will be discussed too.

Rohan Akolkar – Bio-sketch

Rohan Akolkar is the Milton and Tamar Maltz Professor of Energy Innovation at Case Western Reserve University (CWRU). He is an Ohio Eminent Scholar in Advanced Energy Research, serves as Faculty Director of CWRU's Great Lakes Energy Institute, and holds joint appointment as Chief Scientist at Pacific Northwest National Laboratory. His research spans many areas of electrochemical engineering: electrodeposition, electrometallurgy, and electrochemical materials development for applications in nano-electronics, batteries, sensors, and in extraction and refining of critical materials. He has made important contributions to fundamental and applied electrochemistry including: patented electrochemical processes and materials which have enabled high-performance interconnects in advanced semiconductor devices; novel electrowinning and electrorefining processes for the extraction and recycling of metals; fundamental studies unraveling mechanisms of dendrite formation in batteries; and a novel sensor for detecting heavy-metal contaminants in water.

Prof. Akolkar received PhD in Chemical Engineering from CWRU in 2004. He worked in industrial R&D at Intel Corporation for 8 years before returning to CWRU as a faculty member in 2012. His research has been recognized by CWRU's School of Engineering Innovation and Research Awards, the Norman Hackerman Award and the Electrodeposition Division Research Award of the Electrochemical Society (ECS), and numerous industry awards during his tenure at Intel. In 2021, he was elected Senior Member of the National Academy of Inventors. He serves as Associate Editor of the Journal of the Electrochemical Society.