I^2CNER Webinar

International Institute for Carbon-Neutral Energy Research (I^2CNER)
Moonshot for beyond Zero-Emission Society
Research Center for Negative Emissions Technologies
Kyushu University

Title Understanding and Controlling Electrochemistry for Electrolyzers and Batteries

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Time& Date 9:00 AM(JST), Wednesday, October 13th, 2021

Abstract

This talk addresses the electrochemical reactivity associated with electrolyzers and batteries. Relevant to electrolyzers we show that electrodeposition of CuAg or CuSn alloy films under suitable conditions yields high surface area catalysts for the active and selective electroreduction of CO_2 to multi-carbon hydrocarbons and oxygenates. Alloy films containing Sn exhibit greater efficiency for CO production relative to either Cu along or CuAg at low overpotentials. In-situ Raman and electroanalysis studies suggest the origin of the high selectivity towards C_2 products to be a combined effect of the diminished stabilization of the Cu_2O overlayer and the optimal availability of the CO intermediate due to the Ag or Sn incorporated in the alloy. Sn-containing films exhibit less Cu_2O relative to either the Ag-containing or neat Cu films, likely due to the increased oxophilicity of the admixed Sn. Incorporation of a polymer into the Cu electrodeposit leads to very active CO_2 reduction electrocatalysis due to pH changes at the electrified interface. Vibrational spectroscopy is used to evaluate the pH at the interface during electrolyzer operation.

Relevant to batteries, we discuss solid electrolytes (SEs) which have become a practical option for lithium ion and lithium metal batteries due to their improved safety over commercially available ionic liquids. The most promising of the SEs are the thiophosphates whose excellent ionic conductivities at room temperature approach those of commercially-utilized electrolytes. Hybrid solid-liquid electrolytes exhibit higher ionic conductivities than their bare solid electrolyte counterparts due to decreased grain boundary resistance, enhanced interfacial contact with electrodes, and decreased degradation at the interface. Spectroscopic and structural studies on these latter materials lead to new formulations and artificial SEI materials exhibiting advantageous properties.

About the Speaker

Professor Andrew A. Gewirth received his A.B. from Princeton University in 1981 and his Ph.D. from Stanford University in 1987. He joined the Illinois faculty in 1988 after postdoctoral work at the University of Texas, Austin. A former Director of the School of Chemical Sciences at the University of Illinois, Professor Gewirth has received a number of awards, among them a Presidential Young Investigator Award and the Department of Energy Outstanding Accomplishment Award in Materials Chemistry.

Gewirth's work addresses chemistry at interfaces, especially the solid-liquid interface in studies relevant to fuel cells, batteries, and other energy related devices. Gewirth uses advanced characterization techniques to examine the mechanism of interfacial electrochemical reactions, and uses the resultant understanding to design new materials and catalysts. He has authored over 280 papers, delivered over 200 invited talks, organized several conferences, chaired a US Department of Energy panel examining the future of electrical energy storage devices, and served as the University of Illinois lead for the Center for Electrical Energy Storage EFRC.

Registration
https://zoom.us/webinar/register/WN_HWuB5XC5QIKAgOjgtzYguw

Host Prof. Miho Yamauchi

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