26th TcSUH STUDENT/POSTDOC SEMINAR

Tuesday, March 26, 2024 - 5:00 pm, HSC 102

Meet & Greet: Food and soft drinks will be served at **4:30** pm!!

Structure Design and Performance Modulation of Water Electrolysis Catalysts

Dr. Luo Yu

Department of Physics

Abstract: Hydrogen (H_2) is an ideal alternative to fossil fuels. We need to embrace hydrogen as a global energy solution now more than ever. Water electrolysis is an efficient technology for green-hydrogen production with zero-carbon emission, which is of great significance to the worldwide decarbonization. However, due to the lack of efficient and low-cost electrode materials, hydrogen production from water electrolysis faces the bottleneck of high cost, which seriously impedes the commercialization of green-hydrogen technology. Focusing on low-cost non-precious metal-based materials, we have performed systematic studies on the structure design and performance modulation of water splitting electrocatalysts. To address the issues of unsatisfactory intrinsic activity, poor durability, and low selectivity, we have proposed heteroatom doping and construction of three-dimensional core-shell structure strategies to modulate the electronic and geometric structures of electrocatalysts. We have uncovered the mechanism of how electronic structure modulates the electrocatalytic water splitting performance and realized selective adsorption and activation of reactants, thus fabricating good water splitting electrocatalysts that can work efficiently under large current densities. Guided by the strategies of heteroatom doping and core-shell structure design, we have further developed a variety of economical and efficient methods for scalable and controllable synthesis of high-performance low-cost electrode materials.

Bio: Dr. Luo Yu is currently a research scientist in Dr. Zhifeng Ren's group. His research has been focusing on developing non-precious metal-based materials and fabricating high-performance devices for hydrogen production from water/seawater electrolysis. He received his B.S. and Ph.D. degrees from Central China Normal University (China) in 2013 and 2018, respectively. From 2016 to 2018, he was a visiting Ph.D. in Dr. Ren's group, and continued to work as a post-doctoral fellow from 2019 to 2021.

Pairing Ga/Al-Zeolites with Tailored Acidity as Tandem Catalysts for the Conversion of Alcohols to Olefins

Amir Abutalib

Department of Chemistry

Abstract: Zeolites, a class of aluminosilicates materials, serve as versatile catalysts owing to their tunable acidity where active sites are either within the crystal framework or as extra-framework species in confined pores. Tailoring Brønsted acidity via heteroatom exchange, such as replacing aluminum with other elements, is common. This process results in less acidic catalysts suitable for series reactions targeting reactive intermediates. This study focuses on synthesizing three zeolites with MWW, CHA, and MFI frameworks as aluminosilicates and gallosilicates, demonstrating their performance in alcohol dehydration reactions, specifically methanol to dimethyl ether and ethanol to ethylene conversions. Ga-zeolites, especially Ga-MCM-22 (MWW), demonstrated outstanding performance, achieving nearly 100% alcohol conversion with high selectivity towards desired products in shorter contact times than most known dehydration catalysts. The catalytic performance is attributed to reduced acid site strength facilitated by a one-pot synthesis, avoiding conventional post-synthesis modifications. Utilizing Ga-zeolites in tandem with Al-zeolites in a dual-bed reactor configuration enhances the conversion of alcohols to valuable intermediates, leading to increased light olefins production. This research highlights the potential of heteroatom-exchanged zeolites in tandem reactions by leveraging their modified acidity and revealing differences in intrinsic acidity as a function of zeolite crystal structure.

Bio: Mr. Amir Abutalib is currently a Ph.D. candidate under the joint guidance of Dr. T. Randall Lee and Dr. Jeffrey Rimer. He obtained his bachelor's degree at the University of Houston in 2021. His current research focuses on the synthesis and catalysis of zeolite materials that contain heteroatoms and metals incorporated into their frameworks.

Additively manufactured M300 maraging steel – process monitoring, microstructure, and performance evaluation

Puskar Pathak

Department of Chemical and Bio-molecular Engineering

Abstract: Laser based additive manufacturing (AM) has gained significant attention that enables fabrication of complex engineering parts with tailored material properties. In this work, we utilize direct energy deposition (DED) based AM technique to study the microstructure and performance of M300 maraging steel alloy system. In-situ infrared (IR) camera was used to monitor the melt pool for process control, yielding > 99.8% dense as-printed parts. Different heat treatment conditions were implemented on as-printed parts, and their respective microstructure and mechanical properties were studied. Internal defect analysis of as-printed part with X-ray computed tomography (CT) showed no internal cracks and inclusions and only small trace of gas-induced and lack of fusion pores. A cellular and columnar dendritic structure microstructure with martensitic matrix and austenite phase were observed due to rapid solidification without any major chemical segregation. The heat treated M300 components resulted in enhanced micro-hardness and tensile properties, comparing with conventionally manufactured M300 alloy counterparts. This project showcases a layout for AM material processing, offering the potential for the development and characterization of new alloy systems.

Bio: Mr. Puskar Pathak is currently a Ph.D. candidate in the Department of Mechanical Engineering under Dr. Venkat Selvamanickam. He obtained his master's from Advanced Manufacturing Technologies from Skolkovo Institute of Science and Technology (Skoltech) and bachelor's degree in Mechanical Engineering from Jawaharlal Nehru Technology University (JNTUK). His current research focuses on developing materials and structures using additive manufacturing (AM) technique for extreme environmental applications.

Persons with disabilities who require accommodations to attend this seminar should call 713-498-9703.