



23rd TcSUH STUDENT/POSTDOC SEMINAR

Tuesday, December 12, 2023 – 4:30 pm, HSC 102

Meet & Greet: **Food and soft drinks** will be served at 4:00 pm!!

Polyurethane Shape-Memory Polymers with Embedded Au-Ag Nanoshells for Triggerable Structural Transformations

Rafiqul Islam

Department of Chemistry and TcSUH

Abstract: Chlorine-mediated processes play a significant role in producing many value-added products. The chlorine evolution reaction (CER) is essential to this. However, the oxygen evolution reaction (OER) often outcompetes CER. Controlling the selectivity between these two reactions is paramount to designing efficient catalysts for CER. We calculate the binding energies of O*, OH*, OOH*, Cl*, and ClO* with DFT to infer the selectivity between chlorine evolution reaction (CER) and oxygen evolution reaction (OER) on 40 single atom catalysts (SACs) supported on graphene. We propose Mn, Pd and Pt as potential SACs with high selectivity towards CER in an acidic medium. Shape memory polymers (SMPs) have attracted considerable attention in recent years due to their unique ability to recover their original shape under external stimuli such as heat, light, magnetic field, or stress. These unique properties make SMPs promising for a wide range of applications including biomedical devices, drug delivery, and smart materials. Segmented polyurethanes (PUs), an important type of SMPs, have received attention due to their unique properties such as high shape-recovery ability, a wide range of shape-recovery temperatures, attractive tensile properties, and good biocompatibility. In this study, a novel composite material was synthesized by incorporating gold-silver nanoshells (AuAgNShs) into the shape-memory polymer matrix. These polymer matrices are generally constructed by a chemically cross-linked network of prepolymers: poly(10-hydroxydecanoate) (PHDA), polyethylene glycol (PEG), and tri-hexamethylene diisocyanate (tri-HDI). This cross-linking network prevents chain relaxation during temporary shape processing above the polymer's glass transition (T_g) or melting temperature (T_m). SMPs with embedded AuAgNShs can be used when direct heating is not possible. For example, robotics to create self-folding structures or in aerospace to create materials that can change their shape in response to laser irradiation. The effects of the concentration of AuAgNShs on the cross-linking network were studied by differential scanning calorimetry (DSC) and dynamic mechanical analysis (DMA). In preliminary studies using a 508 nm laser, the de-shaped specimen needed only 2-3 seconds to achieve 100% shape recovery.

Bio: Mr. Rafiqul Islam is from Bangladesh. He obtained his B.S. degree in Chemistry from the University of Dhaka, Bangladesh. He then earned a Master of Engineering degree from the Department of Applied Chemistry & Life Science, Toyohashi University of Technology, Japan in 2019. Currently, he is pursuing his Ph.D. in Chemistry under the guidance of Dr. T. Randall Lee with a research focus on polymer and organic materials for energy and biomedical applications. In his free time, he likes to play cricket.

Development and Characterization of Advanced Materials for Chemical Sensing

David Waligo

Department of Physics and TcSUH

Abstract: In recent years gas sensors are increasingly used in our daily life to enhance the ability to perceive our surroundings. Gas sensors are commonly used to automate processes, for instance in industry for quick gas leak detection, automobile exhaust detection, environmental monitoring to control pollution, and in breath analysis to detect drunk drivers. Semiconductor Metal Oxide gas sensor (SMOX) - a special class of gas sensors, utilizes changes in conductivity to detect low concentrations (ppm, ppb) of target gases. Their low cost, simple preparation techniques, and potential scalability are desirable attributes. Recently there have been efforts to use these sensors for medical diagnosis of patients based on the volatile organic compounds in the breath. In the past, the use of volatile organic compounds detection in the breath for medical diagnosis has been limited by the low sensitivity and selectivity of sensors towards the different compounds. A common approach to solve this problem with semiconductor metal oxide gas sensors is incorporation of nanostructures. In this presentation, we propose a sensor array based on advanced nanomaterials with an objective to improve sensitivity to cancer related malignancies.

Bio: Mr. David Waligo is currently a Ph.D. candidate (4th-year) in the Department of Physics under the supervision of Prof. Oomman K. Varghese.

The Promise of Organic Batteries: Overview and interplay mechanism

Alae Eddine Lakraychi

Department of Electrical and Computer Engineering and TcSUH

Abstract: Since 2008, organic batteries have witnessed a revived interest due to their credible promise in promoting safe and low-polluting electrochemical energy storage systems. This includes a broad applicability as bulky solid or dissolved active materials, in solid-state, aqueous or non-aqueous electrolyte, for portable and stationary batteries, respectively. Today, a plethora of organic molecules have been proposed and evaluated as both positive and negative electrode materials. Some of them already exhibit attractive electrochemical performances, whereas others are still under exploration and investigation. However, the realization of organic batteries is still plagued by rapid capacity fade due to the dissolution of active material and poor understanding of charge storage mechanism during battery operation. This contribution aims to provide a brief overview of the organic batteries field and to showcase our advances in understanding the charge storage mechanism and overcoming the dissolution issue. More specifically, we demonstrate how a COF-based membrane can be used as separator to block the crossover of soluble organic species and improve its cyclability; and by means of organic synthesis and in-situ diffraction characterization, we try to elucidate the redox reaction pathway and phase transition of organic material in the presence of various charge carriers.

Bio: Dr. Alae Eddine Lakraychi obtained his B.S. (Chemistry) and Ph.D. (Materials Science) from the University of Picardy Jules Verne (France) under the supervision of Dr. Franck Dolhem and Dr. Matthieu Becuwe. After completing a postdoctoral fellowship at the Catholic University of Louvain (Belgium) in Prof. Alexandru Vlad's group, he joined the University of Houston as a postdoctoral fellow in Prof. Yan Yao's group. His current research focuses on developing innovative organic materials for energy storage and harvesting applications.

Persons with disabilities who require accommodations to attend this seminar should call 713-743-8212.