11th TcSUH STUDENT/POSTDOC SEMINAR

Monday, April 11, 2022 - 5:00 pm, HSC 102

or join by Zoom:

(Meeting ID: 912 8116 7561, Passcode: 540375): https://tinyurl.com/5chf63r6

Meet & Greet: Snack and soft drinks will be served at **4:30** *p.m!! (RSVP)*

Photoinduced electron-phonon dynamics on $MoTe_2$ studied by MeV ultrafast electron diffraction

Sumit Khadka

TcSUH and Department of Physics

Abstract: Layered Transition Metal Dichalcogenides (TMDs) such as $MoTe_2$ have received considerable attention due to its suitability for next generation fast electronic switching devices. This is attributed to the presence of slight differences in the lattice parameters between the topological phases of $MoTe_2$ and suitability to switch between phases by application of temperature, strain, pressure, light etc. Recently, the ultrafast electron diffraction (UED) experiment on T_d WTe_2 revealed the emergence of A_1 phonons in response to THz radiation while transient optical studies on $MoTe_2$ have revealed similar responses on T_d $MoTe_2$. In this work, we use MeV UED to observe the dynamical responses of the topological phases of $MoTe_2$ in response to 800 nm pump beam. In addition, combined with fluence dependent UED, we discuss the possible mechanisms associated with the electron-electron coupling and electron-phonon coupling that drives the photoinduced phase transition between the topological phases of $MoTe_2$. Our results open possibilities to understanding how lattice structures determines electronic and topological properties on $MoTe_2$.

Bio: Mr. Sumit Khadka is currently a Ph.D. candidate in Dr. Byron Freelon's group in the Department of Physics and Texas Center for Superconductivity at University of Houston.

Constructing Favorable Microstructures in Solid-state Organic Cathodes via Mechanical Property Manipulation

Zhaoyang Chen

TcSUH and Materials Science and Engineering Program

Abstract: Organic electrode materials are competitive alternatives to inorganic materials for solid-state batteries (SSB). However, the low-modulus organic materials and high-modulus sulfide electrolytes, upon mixing and compression, would form unfavorable composite microstructure where electrolyte cannot form an efficient ion conduction path. This mismatch in mechanical property prevents a high fraction of organic compounds to be used in SSB. Here we report the formation of favorable microstructures of organic cathodes by "softening" the sulfide electrolytes. The organic cathode formed by mixing with this softened electrolyte shows a favorable microstructure. As a result, the utilization of an organic material, pyrene-4,5,9,10-tetraone (PTO), is increased by 133.6% and 90.8% compared with cells with a re-hardened and the pristine Li_6PS_5Cl, respectively. Our exploration of softened electrolyte is applicable to other active materials with low modulus.

Bio: Ms. Zhaoyang Chen is currently a Ph.D. candidate in Dr. Yan Yao's group in the department of Electrical and Computer Engineering and Texas Center for Superconductivity at University of Houston.

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

Detection of Human Stress Hormones by Skin-Attachable Piezoelectric Single-Crystalline III-N Thin-Film Sensor

Nam-In Kim

TcSUH and Materials Science and Engineering program

Abstract: Wearable sensors are becoming more important in personal healthcare monitoring systems, especially for the continuous and non-invasive measurements of body conditions. Among many physical and physiological parameters, in the present study, we focus on the level of stress, which is one of the major threats to human health in modern society. In collaboration with Dr. Wosik group, we developed a skin-attachable sensor that can measure cortisol from the sweat of the stressful human body. We employed bio-compatible and mechanically-flexible piezoelectric III-N thin film for the sensor element, which shows a specific resonant frequency and can be easily modified with a functionalized surface. When the target substance (cortisol) interacts with the sensing layer, its mass applies a force to a piezoelectric material, causing the resonant frequency shifted by the Sauerbrey equation. Single-crystalline III-N thin film offers excellent sensitivity due to its high initial resonant frequency in the range of several GHz. The performance of the sensor was measured and analyzed using different conditions.

Bio: Mr. Nam-In Kim is currently a Ph.D. candidate in Dr. Jae-Hyun Ryou's group in the department of Mechanical Engineering, Advanced Manufacturing Institute, and Texas Center for Superconductivity at University of Houston.

Revised activity descriptor for recombinative hydrogen desorption

Chenghao Wang

TcSUH and Department of Chemical Engineering

Abstract: The widespread adoption of water electrolysis using renewable energy for the sustainable production of H_2 is partially hindered by the scarcity and high price of Pt, the catalyst of choice for the hydrogen evolution reaction (HER). The empirical correlation between the metal-hydrogen binding strength and HER activity was first reported by Trasatti in 1972 and later popularized by Nørskov et al. According to this correlation, the high catalytic activity of Pt for HER has been attributed to its optimal binding strength of hydrogen.

Despite the widespread adoption of the correlation, the optimal activity requirement of $\Delta G=0$ has shortcomings. Zero coverage values are often unrealistic and attempts to estimate ΔG near saturation coverage are futile, because thermodynamics dictate $\Delta G=0$ at equilibrium.

We observed that the two H* atoms involved in the Tafel step on equilibrated surfaces typically bind in two different types of sites. When using the binding energy difference ($\Delta\Delta G$) between the weaker and stronger binding sites as a descriptor instead, we show that it linearly correlates with E_a for pure transition metals. Notably, we identified several deviating single atom alloys (SAAs) which have significantly lower E_a than expected and could be interesting candidates for further investigations.

Bio: Mr. Chenghao Wang is currently a Ph.D. candidate in Dr. Lars C. Grabow's group in the department of Chemical and Biomolecular Engineering and Texas Center for Superconductivity at University of Houston.

Join Zoom Meeting (Meeting ID: 912 8116 7561, Passcode: 540375): https://tinyurl.com/5chf63r6

RSVP BY Friday, April 8 at 2:00 p.m. for Sandwiches (for the seminar attendees), Drinks, and Snacks: https://forms.office.com/r/W8bma7SgVX

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