THE UNIVERSITY *of* EDINBURGH

SCHOOL OF ENGINEERING

IBioE INSTITUTE *for* BIOENGINEERING

Seminar

11:00-12:00 on **6th August**

Sanderson Building, Classroom 2

Dr. Jiantao Zai

The Construction and Application of Electrocatalysts for Sulfur-Based Flow Batteries

ABSTRACT

In the coming years, with the high-proportion integration of wind and solar power into the grid, there is an urgent need to develop electrochemical energy storage with a duration of 4-6 hours to bridge the gap between energy production surplus periods and demand increase periods. Once renewable energy generation comprises 60% to 70% of the power system, long-duration energy storage technologies such as flow batteries with strong intrinsic safety will become the "lowest-cost flexible solution." Sulfur, the 14th most abundant element on Earth, has a high theoretical capacity (1673 mAh/g) and low theoretical cost, making it an ideal energy storage material. However, the large electrode polarization and kinetic disadvantages during the redox process of polysulfides greatly limit the energy efficiency and stability of sulfur-based flow batteries. Therefore, it is crucial to design the catalytic electrodes to improve the reactivity of polysulfides for the practical application of sulfur-based flow batteries.

To improve the catalytic activity of electrodes towards polysulfides, we propose the use of the theory of semiconductor junctions to guide the regulation of electron density at the catalytic centers. Under this research approach, we have explored various copper-based sulfides and selenides with different morphologies. Additionally, we have successfully prepared heterogeneous junctions such as CoS_2/CoS, hollow VO_2/VS_x, CNT-molecular catalysts, and developed Cu_4S_7 hollow nanoparticles alongside Cu_2CoGeS_2 and $CuFeS_2$ nanocrystals. By adjusting the electronic structure of the active sites, the redox reaction of polysulfides is significantly promoted. When these materials are applied to aqueous polysulfide/iodide redox flow batteries (SIFBs) and lithium-sulfur batteries, both energy storage efficiency and long-term cycling stability are improved.

SPEAKER

Dr. Zai received his Ph.D. from SJTU in 2012 and then engaged in postdoctoral research at Pennsylvania State University in the United States in 2013. After returning to China in 2014, he joined the School of Chemistry and Chemical Engineering (SCCE) at Shanghai Jiao Tong University (SJTU). Currently, he is focusing on catalysis based on semiconductor junctions, which can regulate the electronic structure of active centers and improve the activity of flow batteries and electrosynthesis. He has published more than 120 SCI papers, including two in Nature Communications, two in Angewandte Chemie International Edition, and others. He was honored with the first prize of the Shanghai Natural Science Award in 2015 and was selected for the Shanghai ChenGuang and Rising-Star Programs in 2018.