澳門大學
UNIVERSIDADE DE MACAU
UNIVERSITY OF MACAU

應用物理及材料工程研究院
INSTITUTO DE FÍSICA APLICADA E ENGENHARIA DE MATERIAIS
INSTITUTE OF APPLIED PHYSICS AND MATERIALS ENGINEERING

IAPME Seminar

Atomically dispersed transition metal sites as heterogeneous or homogeneous catalysts for high-performance lithium-sulfur batteries

06 September 2024

Prof. Qingchun ZHANG
Southwest University of Science and Technology

Venue: N23-1004b
Time: 14:10 – 15:30

Abstract:

The rechargeable lithium–sulfur batteries (LSBs) are considered as one of the most promising candidates for the next-generation renewable energy storage systems due to the abundant and eco-friendly sulfur and an ultrahigh theoretical energy density of 2600 Wh kg−1. Nevertheless, a multitude of obstacles have severely hindered their commercial application. To begin with, the soluble lithium polysulfides (LiPSs) usually diffuse and shuttle between the cathode and anode, resulting in irreversible capacity fading. Another detrimental concern lies in the sluggish redox reactions, which accordingly trigger LiPS accumulation and deteriorate sulfur utilization. Beyond that, the dendrites result from the unfavorable lithium plating and stripping procedure, which not only degrades the electrochemical performance but also produces potential safety issues. Recently, various transition metal oxides, sulfides, selenides, phosphides, and nitrides have been proposed as electrocatalysts to combat the aforementioned issues. However, the introduction of over-weighted metal compounds inevitably degrades the overall energy density of the LSBs. In our work, atomically dispersed transition sites anchored on suitable substrates or dissolved in electrolytes as heterogeneous or homogeneous catalysts enable maximum atomic utilization and robust catalytic activity. The structure of active sites, reaction kinetics, and catalytic mechanism of LSBs were elucidated by electrochemical analysis, in-situ or ex-situ measurements, and theoretical calculations. These studies have the potential to propel the real implementation of highly efficient and remarkably durable LSBs.

Biography:

Dr. Qingchun ZHNAG is an Associate Professor in State Key Laboratory of Environment-friendly Energy Materials at Southwest University of Science and Technology. He got his PhD degree in Materials Science and Engineering from the Southwest University of Science and Technology in 2018. From 2021 to 2022, he worked at University of Macau as a Postdoctoral Fellow. He joined the State Key Laboratory of Environment-friendly Energy Materials as a Distinguished Associate Professor in 2018, and was promoted to Associate Professor in 2024. His current research focuses on development of catalysts based on transition metal complexes and dual-atom catalysts for CO2 reduction reaction, lithium-sulfur batteries, and the mechanism study. He has published more than 30 papers in international peer-reviewed journals, such as, Appl. Catal., B, J. Energy Chem., and Next Energy.

Enquiry: Prof. Pan (huipan@um.edu.mo)