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Invited Talk:

Mixed-Dimensional Heterostructures and Their Clean Energy Applications

Abstract: Compared with their three-dimensional counterparts, two-dimensional (2D) van der Waals (vdW) materials exhibit quantum confinement where charge carriers are spatially confined at the physical boundaries. Particularly, when mixing 2D materials with other low-dimensional (LD) materials, they exhibit enormous potential in electrochemical energy applications due to the reduced dimensionality and, more importantly, material integration synergy, resulting in controllability over mixture composition, layer stacking and arrangement, and interlayer coupling. In this article, the latest advancements in 2D vdW heterostructure and their mixed lowdimensional hybrids (MLDHs) are reviewed with an emphasis on innovations covering hybrid structure construction and electrochemical applications. Recent developments leveraging the 2D vdW platform to promote a mechanistic understanding of charge-transport dynamics at the electrified interface were highlighted. Fundamental insight into the synergistic effect of MLDH integration for advancing the development of electrochemical energy applications was discussed. The knowledge gained on how mixed-dimensional physics and chemistry influence the performance of metal ion batteries and electrocatalytic hydrogen evolution reaction will shed light on the design principle of the electrode materials and deepen the understanding of the process–structural–property–performance relationship of the vdW-based MLDHs.



Biography: Fei Yao received her dual Ph.D. degree in Energy Science from Sungkyunkwan University (SKKU), Korea and in Physics from Ecole Polytechnique, France, in August 2013. From 2013 to 2015, she worked as a postdoctoral researcher under the guidance of Prof. Young Hee Lee in the Center for Integrated Nanostructure Physics (CINAP), Institute for Basic Science (IBS), Korea. From 2015 to 2017, she worked with Prof. Alan Seabaugh as a postdoctoral research associate in Electrical Engineering, University of Notre Dame, USA. Currently, she is a research assistant professor in the Department of Materials Design and Innovation. Her research

interests include low-dimensional materials synthesis, property engineering, and their applications in electrochemical energy storage and conversion, electrochemical sensors and electronic devices.