In-situ/operando spectroscopic studies of electrochemical energy reactions

Shi-Gang SUN
State Key Laboratory of Physical Chemistry of Solid Surfaces, College of Chemistry and Chemical Engineering and College of Energy, Xiamen University, Xiamen 361005, China.
Email: sgsun@xmu.edu.cn

Abstract: Understanding the reaction mechanism at molecule level and monitoring the structure and its evolution at atomic/microstructural scale are of significant importance in developing electrochemical applications. Traditional electrochemical methods use potential or current as both stimulation and detection signals, and can provide phenomenological results on electrode reaction mechanism and kinetics, and have also advantage in counting accurately electrons transferred in reactions. While the traditional electrochemical methods lack of molecule recognition ability and can not detect electrode structure and its evolution. Therefore, to develop electrochemical in-situ/operando spectroscopic methods is the key to gain knowledge on electrochemical reactions at molecule level and at atomic/microstructural scale.

This communication reports our recent progresses in studies of electrochemical energy processes involved in both energy conversion (Fuel Cells) and storage (Batteries) through developing in-situ/operando spectroscopic methods, including Fourier Transform Infrared Spectroscopy (FTIRs), Nuclear Magnet Resonance (NMR), On-line Electrochemical Mass Spectroscopy (OEMS), Electrochemical Quartz Crystal Microbalance (EQCM), X-Ray Diffraction (XRD), Transmission Electron Microscopy (Operando-TEM), and Synchrotron-based X-Ray Spectrometry (XRS). The results allowed to achieve a deep understanding of electrode structure evolution and reaction mechanism at microstructure and molecule level. In addition, the first infrared free electron laser and spectroscopic facilities for energy chemistry studies building up in China will be briefly introduced.

Acknowledgements. This work was supported by NSFC (21621091, 21327901) and the MOST (2015CB251102, 2016YFB0100202, 2017YFA0206502)
References:

Biography:

Shi-Gang Sun is Academician of Chinese Academy of Sciences, fellow of International Society of Electrochemistry (ISE) and fellow of Royal Society of Chemistry (RSC). He obtained his Bachelor of Science from Xiamen University, China, in 1982, Doctorat d’Etat (Docteur ès Sciences Physiques) from Université Pierre et Marie Curie (Paris VI), France, in 1986. After one-year post-doctoral research in the Laboratoire d’Electrochimie Interfaciale du CNRS, France, he returned to China by the end of 1987, and served as associate professor and later full professor in 1991 at the Department of Chemistry of Xiamen University till now. His main research interests include Electrocatalysis, Electrochemical Surface Science, Spectroelectrochemistry, Nanomaterials and Chemical power sources.