Investigation of Redox Reaction of Platinum during Electrochemical Catalysis Reaction by Ambient Pressure XPS

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Abstract

New energy conversion methods have attracted more attention during the past few decades. Renewable power source such as solar energy and hydrogen fuel gives an alternative method for daily needed. Catalyst acts as a crucial role of the transformation between energy source and useable product. In order to improve and optimize the efficiency of catalytic reaction, scientists dedicate to develop innovative techniques for understanding the real-time changes of catalytic reaction. In order to probe the interaction between catalyst and reactant on the catalyst's surface, the novel near ambient pressure x-ray photoelectron spectroscopy (APXPS) is highly recommended. Recently, some liquid reaction cells adapted with electrochemical apparatus have been developed and allow us to study the liquid-solid interface, such as the changes of an electrochemical catalyst, in electrochemistry applications. Understanding changes in electronic structure of a working electrode will provide us more information to depict the mechanism of the reaction. In this research, we fabricated a homemade in-situ liquid cell to study the redox reaction of the iconic Pt catalyst under different electrochemical condition (Figure.1) at the APXPS end-station of TLS BL24A, at NSRRC. The thickness of water layer generated by electrolyte diffusion from the liquid cell reservoir was first determined. With only few nanometers of water film around the Pt films with 4 nm thickness, the XPS could be collected under the operational condition of electrochemical reaction. Under the biasing process, the Pt electrode will be oxidized under positive voltage while reduced along with negative one, despite the fact that platinum should be stable as a noble metal. The results inspire us to investigate the intermediate species of liquid-solid reaction by supplying the limitation electrolyte.

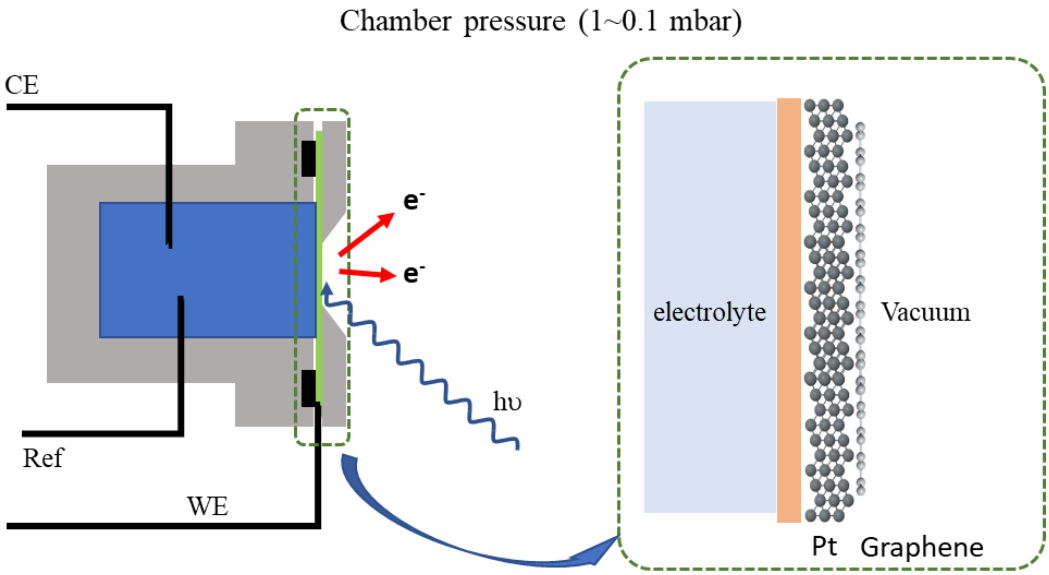

Figure.1 The setup of in-situ experiment of Pt redox reaction investigation.

Keywords – Electrochemical catalyst, APXPS, Liquid-Solid interface