In situ Soft X-ray spectroscopic characterization for electrocatalysis

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Understanding the molecular level foundation of a catalytic reaction is generally acknowledged to aid the design of improved catalytic materials. This contribution is concerned with soft X-ray spectroscopic techniques applied to electrocatalysis in situ. Soft X-ray techniques, namely X-ray photoelectron and absorption spectroscopies, are unique for catalytic science as these allow us monitoring the evolution of light elements such as C, O, N as well as the metallic elements at the same time, thus providing information not only on the nature of the metal in the electrode but also the chemical speciation of adsorbates and any component across the reactive interface. However, these techniques require a vacuum environment, which poses big challenges in terms of cell design that can accommodate the use of a liquid electrolyte. Hence, operando techniques have become very popular in the scientific community to help achieve this goal as demonstrated by a flourishing number of dedicated studies [1-3] and other initiatives for discussion [4-6]. In this contribution, I will present recent technical advancements in the characterization of the CO_2 reduction reaction (CO_2RR) and current understanding of the reaction mechanism based on these methods [7-11].

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