Development and application of liquid phase in-situ XAS in tender X-ray for catalysis and energy research

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X-ray absorption spectroscopy (XAS) is a useful technique for studying electronic and structural properties of materials. When these measurements were performed in-situ, it is valuable to identify the reactive species and monitor the reaction kinetics. This could significantly improve our understanding of material property and advance our ability of rational design of material with improved performance. Many of the in-situ studies were traditionally performed in solid state using hard X-rays. However, many processes, such as catalytic reactions and energy related applications, such as water splitting reactions, CO_2 reduction and lithium ion batteries occur in liquid phase. And these reactions are increasingly involved with elements/edges in the tender X-ray region (2-4 keV), for example, S K-edge, P K-edge; K-edge of 3d transition metals; and L-edge of 4d metals. Different in-situ liquid cells are required for different applications.

In this presentation, we will report the recent development of various in-situ liquid cells and chamber for studies of catalytic and energy materials in liquid the SXRMB beamline at the Canadian Light Source. Examples of applications will include (a) the concentration and solvation effects of selected Fe standards using the in situ liquid XAS; (b) in-situ study of structure, composition and formation of various catalysts; (c) Finally, different liquid cells have been designed at the SXRMB for high temperature liquid reactions, water splitting, coin cell batteries and the electroreduction of CO_2.

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