

Soft X-ray Spectroscopy and Imaging Applications in Studying Energy Nanomaterials

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Electrochemical energy conversion devices (for example fuel cell) and energy storage devices (for example battery and super capacitors) offer great prospects for the most efficient and cost-effective utilization of energy. Many of these systems require the development and application of novel functional carbon nanostructure, for example, CNT and graphene and their hybrid with other nanocomponents. In order to aid in designing of better performance electrochemical devices, a deeper scientific understanding of these materials will require new analytical tools that will shed light on their structure and electronic properties. The Canadian Light Source synchrotron is one such tool. Techniques, such as the element specific probe X-ray absorption near-edge structures (XANES) spectroscopy, can supply detailed information on the local chemistry of the absorbing atom. XANES has been successfully applied to investigate the chemical bonding, electronic structure, and surface chemistry of nanomaterials. In addition, scanning transmission X-ray microscopy (STXM), based on the X-ray absorption process, has a chemical contrast mechanism to allow for imaging at the nano-scale. In this talk, we will present various studies on CNT, graphene and metal or metal oxide/carbon nanotube/graphene hybrid being used in Li-ion battery, fuel cell and Li-O₂ battery, and thereby shows the importance of novel analytical techniques in the development of energy storage systems. We will also briefly describe our efforts in developing in situ soft X-ray for electrochemistry study.