

Ex-situ and operando characterization of batteries and energy related materials using synchrotron-based infrared microspectroscopy



Ibraheem YOUSEF

ALBA Synchrotron light source, Spain

iyousef@cells.

Abstract

Fourier transform infrared (FTIR) spectroscopy is based on the absorption of infrared light by the molecules present in the sample of interest. The technique is a non-destructive (photon energy \ll 1 eV) and particularly useful for exploring the chemical composition of materials at the molecular level. FTIR microspectroscopy has gained prominence in this field as one of the powerful analytical techniques that provides valuable insights into the chemical and structural changes occurring within battery materials and electrochemical cells, enhancing our understanding of their behavior and performance. Coupling synchrotron radiation with FTIR microspectroscopy (SR- μ FTIR) has great potential to study ex-situ and operando battery materials, as the synchrotron infrared source is 100–1000 times brighter than a conventional thermal (e.g. Globar) sources. Moreover, its high brightness (i.e. flux density) allows smaller regions (3–10 μ m) to be probed in microscopy using different operation modes like transmission or reflection, suitable for ex-situ and operando battery analysis with an acceptable signal-to-noise ratio. This contribution will shed some light on the role of FTIR microspectroscopy in battery research performed at MIRAS beamline, highlighting its contributions to the advancement of energy storage systems and the quest for sustainable and high-performance battery solutions.

Bio

Ibraheem Yousef is responsible of the infrared microspectroscopy beamline MIRAS at ALBA synchrotron light source in Barcelona (Spain). He obtained his Ph.D. from the University of Pierre and Marie Curie in Paris. His research performed at SOLEIL synchrotron in Paris entitled “Simulation and design of an infrared beamline: applications in microspectroscopy and imaging”. Since 2011 until 2015, he has been working as a responsible of the Infrared microspectroscopy beamline at the SESAME synchrotron in Jordan. His research concerns synchrotron-based Fourier-transform infrared microspectroscopy and imaging. He developed several research projects in

material sciences and biomedical applications, using synchrotron infrared radiation. He is in particular, involved in research directions related to ex-situ / operando characterization of batteries and energy related materials, high pressure studies, radiobiology, and polymers in the Mid- and Far-IR spectromicroscopies. Dr. Yousef produced important contributions published in refereed journals total of 60 articles and presented at international conferences.