Contribution ID: **56** Type: **Oral Presentation**

The current and future opportunities of battery research activities at MIRAS beamline of ALBA synchrotron light

Thursday, November 30, 2023 10:00 AM (20 minutes)

Ex-situ and operando battery research play a crucial role in the development and improvement of energy storage technologies. One of the powerful analytical techniques that has gained prominence in this field is Fourier Transform Infrared (FTIR) microspectroscopy. This technique provides valuable insights into the chemical and structural changes occurring within battery materials, enhancing our understanding of their behavior and performance.
Coupling synchrotron radiation with FTIR microspectroscopy (SR-μFTIR) 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.[1] Moreover, its high brightness (i.e. flux density) allows smaller regions (3–10 μm) 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.[2]

The material science program at MIRAS end station devoted to Fourier Transform Infrared micro-spectroscopy (μFTIR) has grown significantly at the beamline during the recent years, in particular, in the fields of batteries and electrochemistry [3-6].
The beamline design and the availability of specific detectors with different detection spectral ranges allows optimizing the performance in the Mid-IR and Far-IR regions to cover a broad wavelength range from ~1μm to ~100μm [7]. That made the technique particularly a robust tool to probe many of the fundamental spectral features of the organic and inorganic materials used in batteries.
In this participation, we will present an overview of the applications and significance of FTIR microspectroscopy in ex-situ battery research performed so far at MIRAS beamline. It will be demonstrated how SR-FTIR microspectroscopy allows to investigate fundamental processes such as the solid-electrolyte interphase (SEI) formation. By characterizing the chemical composition, surface chemistry, and molecular interactions within battery components. Furthermore, we are at the initial steps of exploring how FTIR microspectroscopy can be employed to monitor and diagnose battery performance under various Operando conditions and cycling protocols.

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.

[1] G. P. Williams et al., Appl. Opt., 1983, 22(18), 2914–2923, DOI: 10.1364/AO.22.002914.
[2] J. A. Reffner, et al., Rev. Sci. Instrum., 1998, 66(2), 1298, DOI: 10.1063/1.1145958.
[3] J. Forero Saboya et al., Energy and Environ.Sci., 13 (2020) 3423, DOI: 10.1039/d0ee02347g
[4] C. Bodin et al., Batteries & Supercaps (2022), DOI.org/10.1002/batt.202200433
[5] A.P. Black et al., Chemical Science 14(2022) 1641, DOI: 10.1039/d2sc04397a
[6] D. Monti et al. ACS Appl. Energy Mater. 6 (2023) 7250, DOI.org/10.1021/acsaem.3c00969
[7] I. Yousef, et al. SRN, Vol. 30, No. 4, (2017), DOI.org/10.1080/08940886.2017.1338410

Primary author: Dr YOUSEF, Ibraheem (ALBA Synchrotron)

Co-author: Dr PONROUCH, Alexandre (2Institut de Ciencia de Materials de Barcelona (ICMBA-CSIC))

Presenter: Dr YOUSEF, Ibraheem (ALBA Synchrotron)