Probing the Ion Flux at the Nanoscale with Operando Technologies

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Understanding local electrochemical processes in energy storage electrodes is crucial for designing efficient materials for batteries and supercapacitors. This underscores the pivotal role of advanced electrochemical characterization techniques, which will be illustrated through several examples.
Firstly, Electrochemical Quartz Crystal Microbalance (EQCM) and Electrochemical Dilatometry (ECD) techniques were employed to track ion fluxes during cation insertion in 2D materials such as TiS2, MXene, and rGO [1-3]. The results highlight the key role of electrolyte-material interactions and suggest that the observed improvements in electrochemical performance could be attributed to partial desolvation of electrolyte ions due to their confinement in interlayer spacing [3,4].
In the final part, we will introduce a novel in-plane electrochemical impedance spectroscopy technique used to deconvolute the ionic and electronic contributions in LiFePO4 and Na3V2(PO4)3F2 electrodes during operation [5]. This innovative setup provides a new tool to further evaluate and enhance the performance of electrode materials for energy storage devices by offering new insights into the electronic and ionic transport mechanisms in electrodes during operation.

References

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