

Understanding the (De)Sodiation Mechanisms in Na-Based Batteries through Operando X-ray Methods



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Invited for this month's cover picture is the review team led by Carmen Cavallo (University of Oslo). The cover picture shows a team of scientists performing *operando* studies on a sodium battery, as if it were a real patient in a hospital. *Operando* X-ray methodologies deliver valuable information about the structural, atomistic, and morphological changes while the battery is actually in its working state. Read the full text of the Review at 10.1002/batt.202000294.

What do you consider the exciting developments in the field?

We think the development of *operando* X-ray-based techniques that can characterize amorphous phases during cycling is the most exciting insight of our Review. For many years, we have been able to trace the crystalline phases during cycling through *operando* XRD, but now we are seeing several studies on for instance *operando* PDF and EXAFS that can also study the amorphous intermediates. Combined with imaging techniques we can get a comprehensive overview of how the materials behave during cycling, which is crucial to improve their performance.

What future opportunities do you see?

In the near future, we expect to see the use of techniques combining X-ray methods with TEM, AFM, and Raman for *operando* sodium-ion battery (NIB) studies. In combination, this suite of *operando* methods will provide complete descriptions of NIBs. Further developments and optimization of the new materials and chemistries will require understanding not only of bulk processes but also of the interfaces between various materials and components. Thus, we expect the rise of surface *operando* techniques such as Raman and Fourier transform infrared (FTIR) spectroscopies as well as X-ray surface methods soon.

What was the inspiration for this cover design?

Carmen Cavallo, who designed the cover, was thinking about "Diagnosis of a battery as if it were a patient that needs to be cured. We want to take care of our sodium-based batteries and use X-rays to understand what is going on inside them."

