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Neutron diffraction and imaging of degradation and sodium storage process in sodium-ion batteries.

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A way to reduce the world's reliance on conventional fuels is to obtain cost-competitive alternatives to convert and store energy. This could be done by implementing cheap storage devices, such as Na-Ion batteries [1], which are the focus of our investigations. During the first part of the project, major attention was dedicated to the fabrication of Prussian blue analog-based batteries, which are considered a good choice for stationary energy storage devices. However, there are still many unknowns related to this technology [2]. Neutron scattering and imaging allow performing operando experiments during charge-discharge without any repercussions on the battery's functional properties. Neutrons are well suited to measure light elements making them a viable probe to study morphology and composition changes as well as ionic transport processes in Na-ion batteries. We have performed operando tomographic studies of the degradation processes, hereby imaging the dendrite growth process, to investigate the effect of cycling on the morphology and long-term stability of the cell. Dendrite formation and electrolyte degradations are two of the most predominant failure mechanisms in these devices [3]. Thus our studies are highly relevant for getting an insight into the key processes the technology is based on.

[1] A. Mauger, et al., Materials 2020, 13, 3453.
[2] Bingxing Xie, et al., Coordination Chemistry Reviews 2022, 460, 214478.
[3] Huan Shi, et al., Chem. Rec. 2022, 22, e202200112.

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