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Neutron Depth Profiling (NDP) - a versatile tool for studying battery components

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Background
Using sophisticated methods, a deep understanding of the processes in in-situ electrochemistry is achieved. There are only a few ways to study electrochemically relevant processes on different length and/or time scales without influencing the processes themselves. What is needed are probes that cover a sufficient volume of the sample non-destructively and are sensitive to the important charge carriers. In battery research, the observation of the near-surface element lithium (Li) is a challenging topic due to the low sensitivity of Li and other light elements with standard probes such as X-rays or electrons.

Methods
Neutrons are an ideal candidate for this task because they are non-destructive and have a relatively high sensitivity to light chemical elements, can distinguish neighboring elements of the periodic table, have a large beam cross section, and have a high penetration depth for many materials. In particular, the neutron depth profile (NDP) is a method for determining the Li depth profile in the first approximately 100 micrometer. Improvements through higher neutron flux, better detectors [1] and sample design [2] even make it possible to measure a complete battery cell operando [2].

Results/Conclusion
This study characterizes a metal-free polymer-based current collector for high-density lithium metal batteries [3]. The Li distribution with NDP of the polyethylene and carbon black mixture on the surface and inside explains with additional methods the advantages of the PE/C collector over the Cu collector through a significant increase in specific energy and significantly lower costs.

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