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## Exploration and optimization on the structural properties of cathode materials for high-performance lithium and sodium-ion batteries

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Although the research on the cathode materials for lithium-ion and sodium-ion batteries has attracted extensive interest, the deep understanding on their structural properties and the insight into their structural evolution are still lack. By taking advantages of sensitive, penetrative and nondestructive properties of neutrons, we adopted ex-situ and in-operando neutron diffraction techniques to explore the structural characteristics of cathode materials of lithium and sodium-ion batteries, especially the structural evolution of cathodes during cycling in real time. It is revealed that structural defects formed in layered cathodes and they varied upon charging and discharging. Moreover, the visualization of the ion migration pathway in cathode indicated that ions diffused via different hopping paths at different states of charge. Based on the relationship between structural and electrochemical properties of cathode materials, we modified and optimized the performances of cathodes by adopting different synthesis procedures, which are of scientific and practical significance. Besides of the research on cathode materials, the construction progress of Peking University high-resolution neutron powder diffractometer at China Spallation Neutron Source will also be presented.

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