



Monitor the oxidation state and fine structures of mixed anion cathode materials during charge/discharge process in-operando conditions

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1. 背景と研究目的

Materials for Lithium and Sodium batteries are an active field of research. Cationic substitution to improve the battery performance is a path to improve battery performance. In this proposal, we measured materials with and without cationic substitutions to explain for changes in the battery performance improvement. The materials to be tested are FMN bare and substituted ($\text{NaFe}_{0.4}\text{Mn}_{0.3}\text{Ni}_{0.3}\text{O}_2$, $\text{Na}_{1-x}\text{Fe}_{0.4}\text{Ni}_{0.3}\text{Mn}_{0.3}\text{O}_2\text{M}_x$).

2. 実験内容

For In-operando measurements of FMN bare and modified oxide were deposited on aluminum as current collector, a 5 mm hole was performed in the coin cells and covered with Kapton tape to allow the normal operation of the cell. Correct operation of the cells was tested in the lab prior to the synchrotron measurements. All samples were measured in Q-XAS, with measurements time of 2 minutes three times to reduce the noise by averaging the different. The K-edges of each metal (Mn, Fe, Co, and Ni) were measured. The environment of the substituent cations was measured in fluorescence mode.

3. 結果および考察

The modified coin cell allowed to make measurements with good signal-to-noise in all the edges (Mn, Fe and Ni K-edge) for bare and modified FMN. The battery was operative and the voltage was raised from 2.8 V to 4.2 V using a potentiostat, taking QXAS spectra at the voltage of interest.

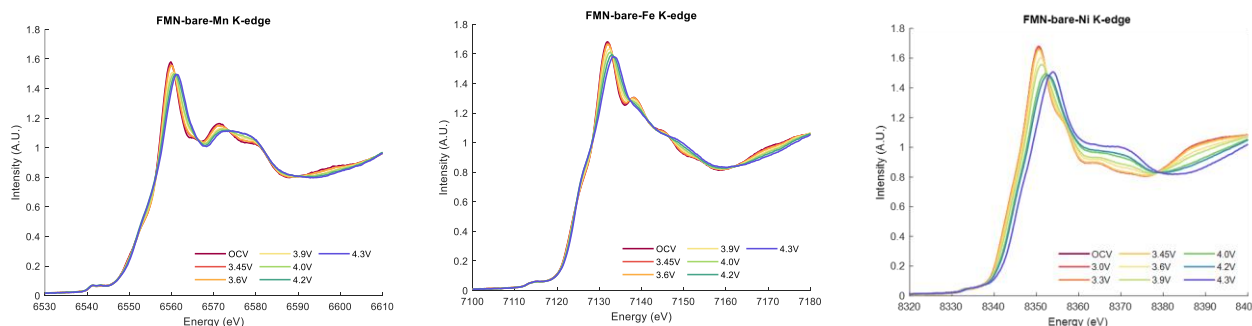


Fig 1 – XANES spectra obtained in-operando for FMN bare samples.

The Ni showed a shift in the oxidation state while Mn and Fe showed changes in the structure due to phase transitions (Fig 1).

The position of the substituent cations could not fully disclosed due to its low concentration. Further measurements will be performed to disclose this cations positions.

4. 参考文献

1. Quartarone et al., ACS Appl. Mater. Interfaces 2020, 12, 45, 50344–50354