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

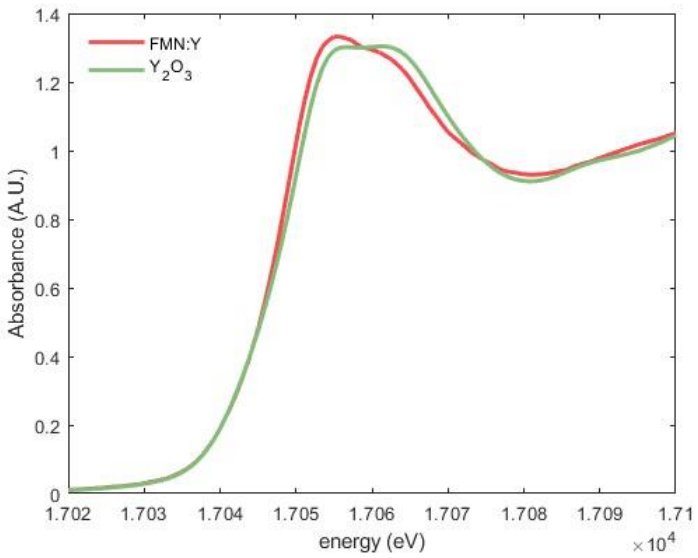
Materials for Sodium batteries are an active field of research. Cationic substitution to improve the battery performance is a path to improve battery performance. In this proposal, we measured the local environment of Y materials with cationic substitutions ($Na_{1-x}Fe_{0.4}Ni_{0.3}Mn_{0.3}O_2Y_x$) to explain changes in the battery performance improvement.

2. 実験内容

The measurements of Y-modified FMN were performed in fluorescence and transmission modes. The energy was calibrated using a Zr metal foil and Y_2O_3 was used as an energy reference to determine the oxidation state.

3. 結果および考察

From transmission mode, the jump was not enough to process the data, instead, the spectra obtained in fluorescence mode were used for the data analysis.



The comparison of the XANES spectra from Y_2O_3 and Y-modified FMN showed a clear difference, indicating that Y in FMN samples has not had the same environment as in Y_2O_3. This observation indicates the Y in FMN samples is not segregated and could be included in the FMN structure.

With respect to the oxidation state, the most common oxidation state is Y(III), but there are reports in the bibliography for Y(II). The comparison of the E0 position in FMN and Y_2O_3 samples shows no shift, indicating the Y in FMN samples is in a trivalent state.

Fig 1 – XANES spectra obtained for Y modified FMN sample obtained in fluorescence mode.

4. 参考文献

1. Kamigawa et al., Appl. Phys. Lett. 108, 122102 (2016).