Application Note BATT1026

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BATT1026: Highly sensitive analysis of trace components in $LiFePO_4$ cathode material

Introduction

$LiFePO_4$ cathode active materials contain trace components resulting from raw materials or impurities from the manufacturing process, which may affect battery performance, life, and safety. ICP-AES is generally used for the analysis of trace components, but the challenge is that certain elements, such as fluorine and silicon, are difficult to measure. Standardless FP method can improve the detection limit by adding a fixed angle measurement that extends the integration time for the element of interest.

Elemental analysis

- **Analysis:** Cathode material
- **Use:** Optimizing electrochemical performance
- **Analyzed materials:** $LiFePO_4$
- **Analysis method:** Standardless FP analysis method

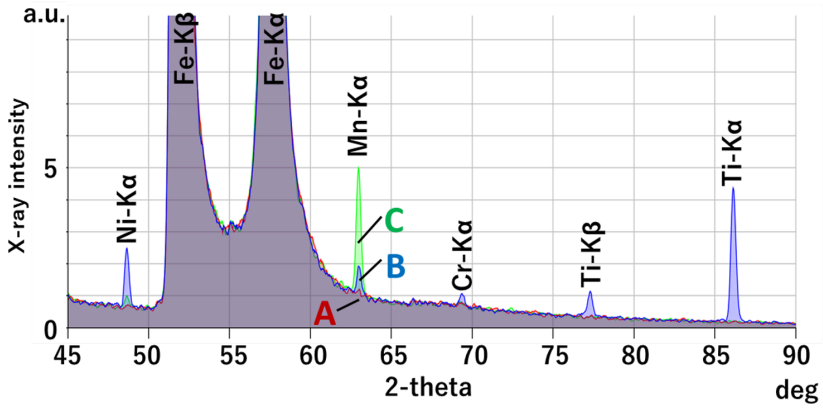

Figure 1: XRF qualitative chart of each sample

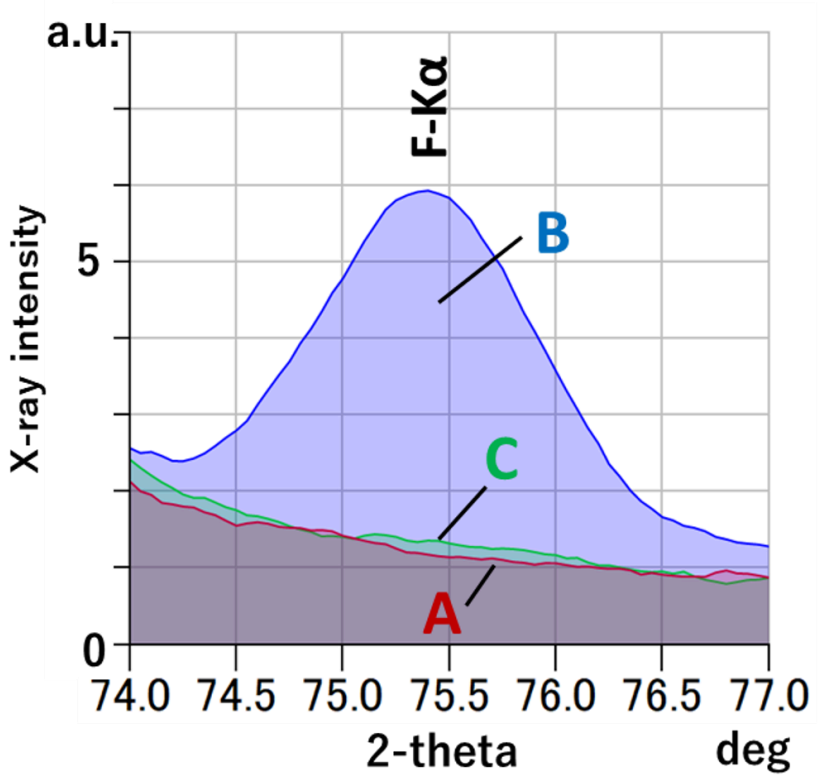

Figure 2: F-Kα qualitative chart of each sample

Table 1: SQX analysis results and theoretical standard deviations of each sample

ppm

Sample	F	Na	Mg	Al	Si	S	Ca	Ti	Cr	Mn	Co	Ni	Cu	Zn	Zr	Pb
A	ND	ND	ND	22	100	57	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
B	9000	45	ND	2760	86	81	32	1590	44	120	41	210	ND	ND	16	ND
C	ND	690	ND	41	78	98	55	ND	ND	520	ND	29	22	ND	ND	ND

ND: less than LLD (detection limit value), LLD: 3 times statistical error in background intensity

Conclusion

For the analysis of trace components, fixed angle measurement can be applied to meet the required quantitation limit. From Figure 1 and Table 1, battery-grade cathode materials (samples B and C) were found to contain impurity on the order of tens to thousands of ppm compared to $LiFePO_4$ reagent (sample A). This implies that the difference between the material grades is high. Furthermore, fluorine, which is difficult for ICP-AES, can be quantitatively analyzed simultaneously with other elements, as shown in Figure 2.

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