Application Note B-XRD1116

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# B-XRD1116 - Operando measurement of laminated lithium ion battery using 2DD

## Introduction

To develop lithium ion secondary batteries with high capacity, high reliability, and long life, it is essential to evaluate the stability of the electrode materials during the charge/discharge process. The laminate cell attachment enables the reproduction of a high-speed charge/discharge process while keeping the sample temperature constant, and simultaneously allows the collection of transmission X-ray diffraction images. Using this attachment with an X-ray diffractometer equipped with a Mo X-ray source and a 2D detector collecting up to 131 diffraction images per second, it is possible to observe the rapid phase transition occurring inside the battery cell.

## Measurement and result

Figure 1 shows a photo of the laminate cell attachment and the 2D detector. $LiFePO_4$ was selected as the positive electrode. Measurement using an exposure time of 10 sec was repeated while charging/discharging the laminate cell at 2C/1C (Here, 1C denotes the current based on ampere-hour rating for total charge / discharge in 1 hour, e.g. the charge at 2C completes in 0.5 hours and discharge at 0.5C does in 2 hours. ) Figure 2 shows a 2D diffraction image observed during the charging process. Diffraction signals characteristic to $FePO_4$ and $LiFePO_4$ were observed in the region indicated by the dotted line. Figure 3 shows the profile map of the region marked in Figure 2, the voltage graph and the diffraction peak intensities of $FePO_4$ and $LiFePO_4$. It was confirmed that the electrode material returned to the same crystal phase as before the measurement started.

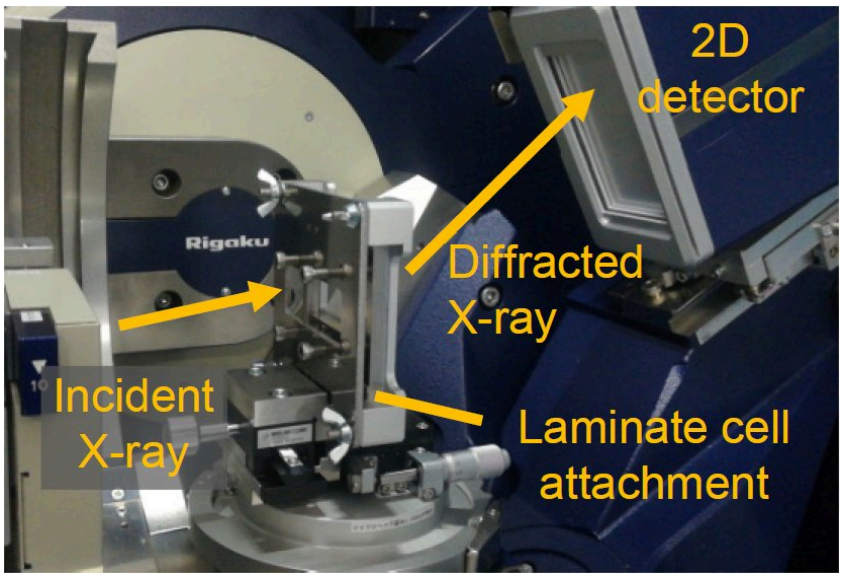

**Figure 1**: Laminate cell attachment.

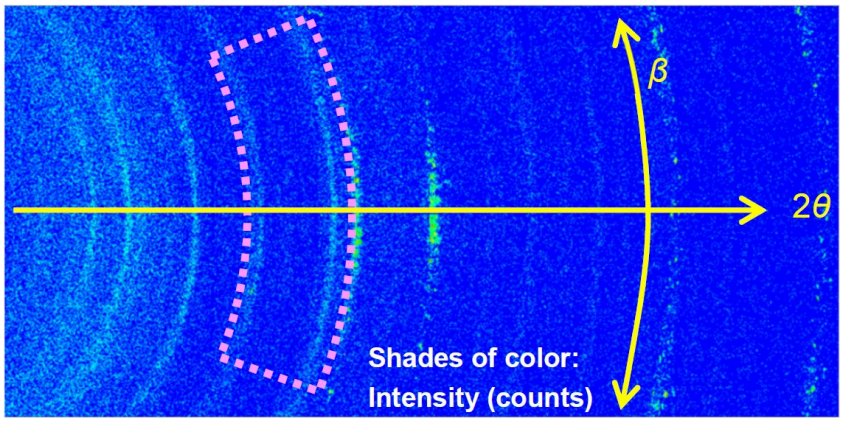


**Figure 2**: A 2D diffraction image observed in the charging process.

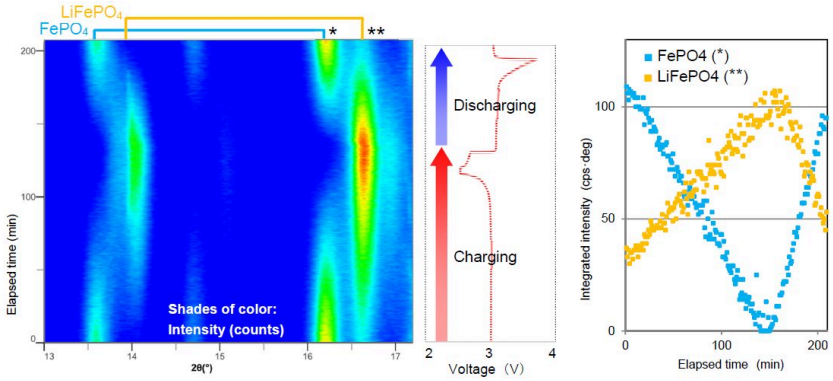


**Figure 3**: The profile map, voltage graph and diffraction peak intensity of $FePO_4$ and $LiFePO_4$.

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