Analytical Imaging with high-energy X-ray Compton scattering is one of the newly developed methodologies for non-destructive characterization of batteries [1, 2]. A method of intensity analysis was applied to a commercial battery, demonstrating its capability for observing lithium migration and internal structure change [1]. Recently we have developed a method of line-shape analysis, which can estimate local lithium concentration in a battery product [3]. In this paper, we present the principle of the line-shape method and its application to a commercial battery.

The line-shape method employs S-parameter, which is defined as the ratio in areas between central and tail parts of Compton-scattered X-ray line. The line-shape depends on constituent elements and their compositions, and thus S-parameter can monitor the variable amount of local lithium ions in battery electrodes. As a demonstration, we have measured S-parameter of a discharging lithium battery (CR2032) as a function of the internal position and discharge time. The result is in Fig. 1. The red region corresponds to the lithium negative electrode and the dark blue region corresponds to the MnO₂ positive electrode. The yellow region corresponds to the olefin separator. Figure 2 shows the time dependence of the normalized S-parameter and the lithium concentration along the white dotted line in Fig. 1.

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