Application of the J-PARC neutron beam to the transmission measurement for a Li ion battery during charge and discharge

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The neutron beam is a suitable probe for studying a lithium ion battery because of its high penetrability. We applied the J-PARC pulsed neutron-beam to the transmission measurement for an 18650-type commercial lithium-ion battery during charge and discharge at J-PARC/MLF/BL09. Fig. 1 shows transmission images of four charge states, which went from (1) to (4). The low penetration areas show the distributions of lithium and hydrogen. The bottom area depends on charge and discharge. This might be due to the variation of electrolyte. We also analyzed the Bragg edge structures seen on the transmission spectra as a function of the neutron wavelength. Fig. 2 shows the examples of a small area of the battery. The graphite {002} edge is seen at 0.67 nm in the discharge state. The edge position moves to the larger wavelength due to the intercalation of lithium in graphite. The edge of LiC_6 {001} is seen at 0.74 nm in the charged state. This result indicates the possibility of imaging of intercalation in the lithium ion battery by the Bragg edge analysis.

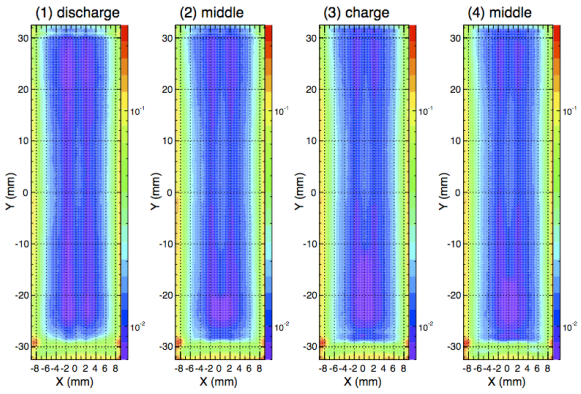

Fig. 1 Transmission images by 0.1-0.8 nm wavelength neutrons
The size of the lithium ion battery is 65 mm in height and 18 mm in diameter. The positive electrode is down in this figure.

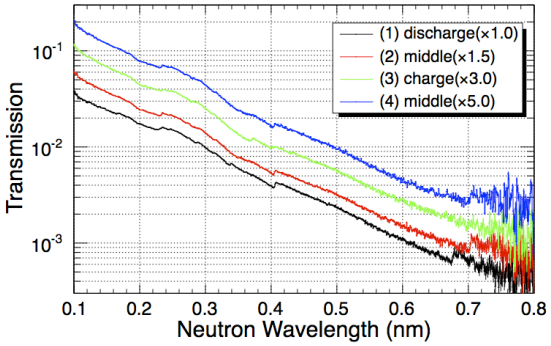

Fig. 2 Transmission spectra in the area of X=−1.8-+1.8 mm and Y= −26-−13 mm

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