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Tracking the Progress of Nonuniform Deterioration in a Lithium-Ion Battery Using Bragg-Edge Imaging – an Application of the AISTANS Compact Neutron Source

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One of the challenges to overcome for commercial lithium-ion batteries (LIB) is suppression of power-storage degradation due to charge-discharge cycles. Some of the present authors (K. Kino and T. Fujiwara) and their collaborators previously reported nonuniform degradation of LIBs nondestructively and quantitatively by a Bragg-edge imaging experiment conducted at a large neutron facility, the Materials and Life Science Experimental Facility of the Japan Proton Accelerator Research Complex (J-PARC).[1] However, further understanding this process, especially clarifying the degradation progression, requires tracking the deterioration of an LIB cell over a long term by repeating Bragg-edge imaging after some charge-discharge cycles. Compact accelerator-driven neutron sources (CANS) are suitable for this research because of their flexible neutron-beam schedule and machine operation with a small number of researchers.
Therefore, we are conducting a long-term measurement of repeated Bragg-edge imaging of a commercial LIB cell for mobile phones after multiple charge-discharge cycles at AISTANS (Analytical facility for Industrial Science and Technology using Accelerator based Neutron Source) [2-4], which is located at AIST (National Institute of Advanced Industrial Science and Technology) Tsukuba in Japan. AISTANS can provide a thermal-cold pulsed neutron beam from a decoupled solid-methane moderator. Thanks to the optimization of AISTANS for Bragg-edge imaging from the most upstream (an electron accelerator) to the most downstream (a neutron detector), we succeeded in imaging three crystalline phases of a negative electrode (graphite, LiC12, and LiC6) in an area of approximately 50×50 mm2 for an initial fresh state. Currently, measurements after charge-discharge cycles are being conducted.
In this presentation, the latest result of tracking progress of nonuniform deterioration for a LIB cell by Bragg-edge imaging will be shown as an application of CANS.

References
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