Poster Presentation

MS79.P09

Development of a new special environment powder neutron diffractomter, SPICA

M. Yonemura[1], K. Mori[2], T. Kamiyama[1], T. Fukunaga[2], Y. Ishikawa[1], R. Tomiyasu[1], Y. Idemoto[3], R. Kanno[4], D. Sulistyanintyas[5], H. Arai[5], Y. Uchimoto[6], Z. Ogumi[5]

[1]High Energy Accelerator Research Organization (KEK), Institute of Materials Structure Science, Ibaraki, Japan, [2]Kyoto University, Research Reactor Institute, Osaka, Japan, [3]Tokyo University of Science, Faculty of Science & Technology, Chiba, Japan, [4]Tokyo Institute of Technology, Department of Electronic Chemistry, Yokohama, Japan, [5]Kyoto Univiersity, Office of Society-Academia Collaboration for Innovation, Kyoto, Japan, [6]Kyoto University, Graduate School of Human and Environmental Studies, Kyoto, Japan

SPICA, a new special environment powder neutron diffractometer was built at BL09 in the Material and Life science Facility (MLF) of the Japan Proton Accelerator Research Complex (J-PARC). This is the first instrument dedicated solely to the study of next-generation batteries in J-PARC and is optimized for in situ measurements to clarify the structural changes of battery materials at the atomic level. Our approach with this diffractometer is to reveal the reactions in batteries and to determine factors of safety and degradation over long periods in practical battery systems. To make in situ measurements of real batteries more fruitful, we need high Δd/d resolution with wider d ranges to detect many phases during chemical reaction, high neutron intensity to know the specific reaction process in high speed charge/discharge, low background and large sample area to install big sample environment and a dedicated chemistry area to carry out long-term scheduled experiments with many sets of on-beam measurements and off-beam charge-discharge measurements. The in situ measurements can be performed in realistic environment with external variables such as temperature, electric field (current density, pulsed current, and etc.), and high pressure in time-resolved conditions by the 2 m sample space. The reliability of the diffraction data has achieved a sufficiently high level for the structural analysis of materials using the Rietveld method. In the beginning stage of the commissioning, the structural changes of the materials, which are dependent on the lithium content in a commercialized Li-ion battery, were clearly observed. The lattice parameters for the anode and cathode materials as a function of the lithium content were extracted from the diffraction patterns. The current status of SPICA will be reported. ACKNOWLEDGEMENT: This work was predominantly supported by the RISING project of NEDO.

Keywords: Neutron, Battery, J-PARC