Modeling the dynamic cycling of a lithium-ion battery for electric vehicle applications

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The lithium-ion battery (LIB) is a preferred power source for the automotive applications such as hybrid electric vehicles and electric vehicles due to its high energy density, high voltage and low self-discharge rate. One of the critical challenges in the use of LIB in electric vehicle applications is to predict the dynamic behavior. For efficient and reliable systems integration, it is important to calculate accurately dynamic cycling behavior of battery in modeling.

In this work, modeling is performed to study the dynamic cycling behavior of a LIB cell comprising a $LiMn_2O_4$ cathode, a graphite anode, and a plasticized electrolyte. The validation of the modeling approach is provided through the comparison of the modeling results with the experimental measurements.

In Fig. 1(a), the current for charge and discharge and the state of charge (SOC) are plotted as a function time. SOC decreases during the cycles in this case. In Fig. 1(b), the voltage output from measurement is compared with that from modeling. Model prediction reasonably reproduces the experimental data. The variations of the current and cell voltage of the battery cell with respect to time are shown for the case of the SOC rise cycles, in Figs. 2(a) and 2(b), respectively. In Fig. 2(b), the voltage outputs from measurement and modeling are in good agreement with each other.

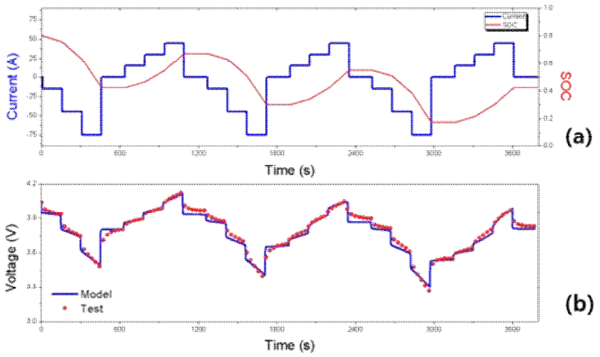

Fig.1. (a) Variations of the current and SOC with time during SOC decrease cycles. (b) Comparison of the variation of cell voltage with time during SOC decrease cycles from the experiment with that from the modeling.

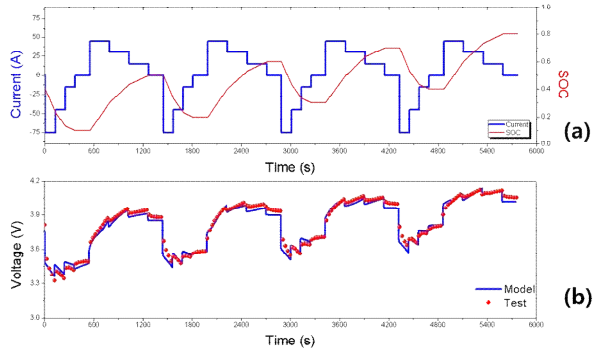

Fig.2. (a) Variations of the current and SOC with time during SOC rise cycles. (b) Comparison of the variation of cell voltage with time during SOC rise cycles from the experiment with that from the modeling.