Single-phase all-solid-state battery with NASICON

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One challenge associated with the fabrication of all-solid-state lithium (sodium)-ion batteries is the interfacial resistance between the electrolyte and the electrode. For the good contact between the electrode and electrolyte, high temperature sintering is typically employed in the case of an oxide-based solid electrolyte. However, high temperature sintering brings a high-resistive layer between the electrode and electrolyte as a consequent of the side reactions. In order to produce ideal interface, a battery made from a single material is one of the best choice. Herein, we report the "single-phase" all-solid-state batteries using a NASICON-based material as the cathode and anode, as well as the electrolyte.[1,2]

All of samples were prepared by the conventional solid-state reaction method. For the electrochemical testing, a thin platinum layer was sputtered on both sides of the resulting pellet (9-10 mm in diameter, *ca.*1 mm in thickness). The cell was subsequently sealed into an HS test cell (Hohsen Corp.) in an Ar-filled grove box. The termination condition for the charge was based on capacity. The termination condition with regard to discharge was always set at 10 mV.

Figure 1 shows the charge-discharge profiles obtained from the $Na_{2.6}V_{1.6}Zr_{0.4}(PO_4)_3$ at 298 K and 5 μA cm^{-2}. It was found that charge-discharge reactions based on the redox reactions of the V^{3+}/V^{2+} (anode) and V^{3+}/V^{4+} (cathode) pairs were underwent at room temperature. The estimated IR drop at 5 μA cm^{-2} and at room temperature was 220 mV, which is good agreement with the charge-discharge overpotential. Therefore, the interfacial resistance was almost zero. The concept of a single-phase battery offers a new approach to achieving high-rate, all-solid-state oxide-based batteries. Single-phase lithium-ion batteries will be also presented.

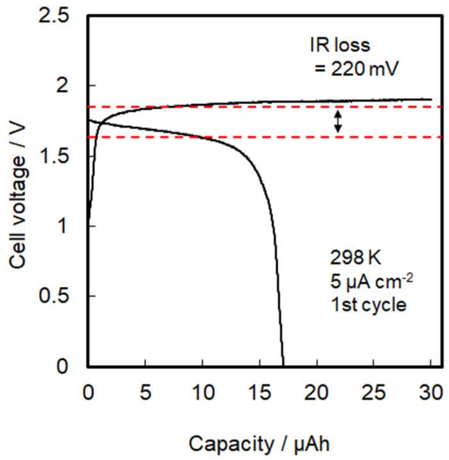

Figure 1 The charge-discharge profiles obtained from the $Na_{2.6}V_{1.6}Zr_{0.4}(PO_4)_3$.

References:
[1] A. Inoishi, T. Omuta, E. Kobayashi, A. Kitajou, S. Okada, Adv. Mater. Int. 2 (2017) 1600942.
[2] A. Inoishi, T. Omuta, E. Kobayashi, A. Kitajou, S. Okada, Chemistry Select 2 (2017) 7925-7929.