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In-situ TEM observation of LiMn2O4 nanowire battery

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For developing long-life lithium ion battery, structure changes at interface between electrode materials and electrolyte have been researched with a number of methods [1]. Among them, transmission electron microscopy (TEM) is one of powerful methods for obtain local information [2].

In this study, we developed a new 'nanowire-battery', consisting of LiMn2O4 crystalline nanowires, ionic liquid electrolyte (ILE) and Li4Ti5O12 crystals for in situ TEM observation and observed charge/discharge behavior in-situ in an aberration-corrected TEM, R005 [3].

Figure (a) shows a series of TEM images of the interface of a bundle of LiMn2O4 nanowires and ILE during electrochemical measurement, e.q. cyclic voltammetry (CV). A bundle of LiMn2O4 nanowires is connected with ILE, which is placed top-right side in Fig (a)⑥. Each image was obtained at the point which is marked in Fig. (b) and (c). Figure (b) shows the applied voltage change and the cell current as a function of time. Voltage (blue line) was swept at 1mV/s. The cell current (red) for nanowire battery was pA order due to extremely small amounts of loaded LiMn2O4 nanowires, cathode materials. The plot of cyclic voltammetry is shown in Fig. (c). Cathodic current peak is shown around 1.5V and anodic current peak, around -0.5V. This indicates that this nanowire battery do work as a battery device.

As shown in Fig (a), the image contrast of the LiMn2O4 nanowire changed as it was charged and discharged. Transmission electron diffraction patterns were also obtained for revealing the relationship of the structure and electrochemical reaction. With the relationship of nanowire shapes, the characteristic interface structure change will be discussed

References

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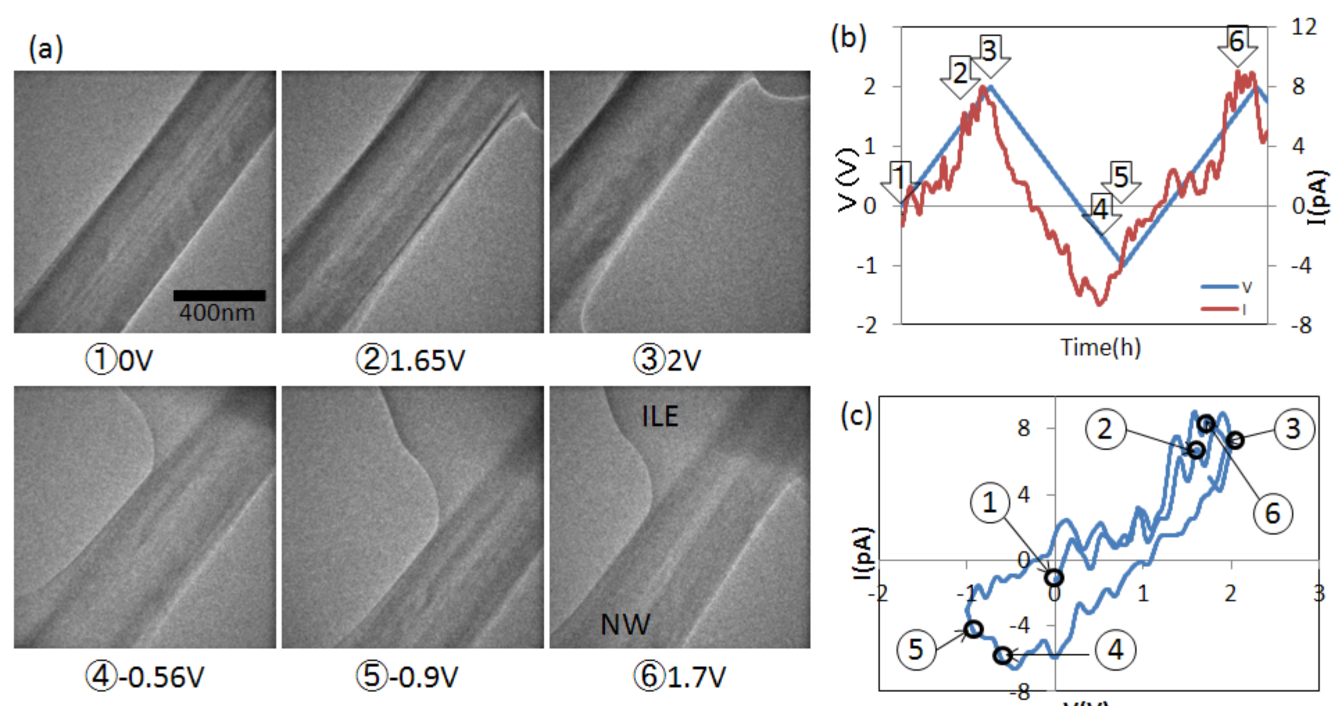

Figure (a) A series of TEM images of a LiMn2O4 nanowire during CV. (b) The applied voltage and cell current during CV (c) The plot of CV. Numbers in each plot correspond to the images in (a).