Electrochemical Properties of Titanium Oxides with Disordered Layer Stacking through Flocculation of Exfoliated Titania Nanosheets

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Two-dimensional nanosheets obtained via the exfoliation of layered compounds have been studied intensively in recent years. Titania nanosheets would be promising candidates as active materials for Li-ion batteries because a large amount of lithium ions can be stored in a nanospace constructed with nanosheets. We have synthesized some porous titania materials constructed from nanosheets by freeze-drying, spray-drying, and soft-chemical processes, which worked as rechargeable electrode materials for the lithium battery [1–4].

In this work, we attempted to produce a new type of layered titanium oxides with disordered layer stacking through flocculation of exfoliated titania nanosheets with H^+ or Li^+ ions. SEM-FIB analyses showed that the spray-dried flocculations were spherical particles with no hollow center. Nitrogen adsorption–desorption isotherms showed that the samples had a mesoporous structure composed of slit-shaped pores.

The product flocculated with H^+ worked as a rechargeable electrode material, as shown in Fig. 1(a). Although rechargeable capacities were gradualry dicreased over the first 10 cycles, a high initial capacity of 300 mAh/g (cut-off voltage: 1.0 V) could be achieved, which approximately correspond to the composition of $Li_{0.9}TiO_2$. On the other hand, the product flocculated with Li^+ gave lower initial capacity and showed a relatively good cyclability, as seen in Fig. 1(b). The charge–discharege properties depended on the type of layer stacking.

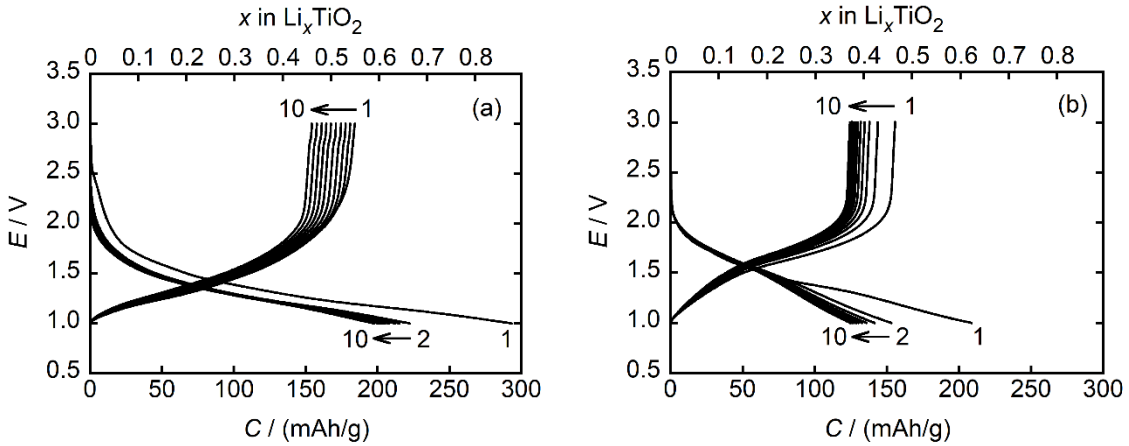

Figure 1. Lithium insertion–deinsertion curves for the layered titanium oxides with disordered layer stacking through flocculation of exfoliated titania nanosheets with (a) H^+ and (b) Li^+ ions.

References:

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