High rate Ti-based anode materials for rechargeable batteries

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Rechargeable batteries used in portable devices and electric vehicles(EVs) and are considered to be the most promising candidate for energy storage system. To realize the energy storage system with rechargeable batteries, we should consider sustainable safety, cycle life, cost, and fast charge/discharge performance. In consideration of the above criteria mentioned, rechargeable lithium batteries are the best choice. However, safety and fast charge are the most urgent issues to be solved. Manganese-based transition metal oxides can be applicable for the positive electrode because of its reliable safety. For the negative electrode, there are several candidate materials. Ti-based materials such as TiO_2 and $Li_4Ti_5O_{12}$(LTO)have been mentioned as alternative negative materials for rechargeable batteries. TiO_2 is one of the promising materials because of the non-toxic, cost, and safety. Also, the LTO is believed the best choice because of the abundance, zero-strain during charge and discharge at a long term, and safety, if the poor rate capability is improved. For the reason, we, here, report the high rate capability was achieved by Ti-based negative materials for rechargeable batteries.

Titanium dioxide was synthesized by hydrothermal reaction of P-25 in highly alkaline NaOH solution. Then the precipitates were transferred to a Teflon-lined stainless autoclave. After being heated at 170□ for 11h, the resultants were washed several times with distilled water until the resulting pH reached neurtal, and then ion-exchanged in HCl aqueous solution. After the ion exchange, the products were calcined at 600□ for 4h in air to produce anatase TiO2 nanorods.

Also, lithium titanates were obtained by a two-step hydrothermal method. According to the above-mentioned process, after ion exchange by HCl, the resultants were mixed with LiOH solution and it again was hydrothermally treated at100□ for 24h in the Tefron-lined autoclave. After washing by ethanol several times until pH7, the collected powders were dried at 80□ in air and heat treated at 800-900□ for 6h in air to obtain LTO nanowires.

As-synthesized the TiO_2 and LTO show single phase XRD patterns. Electrochemical test with Li-metal half cells in voltage range of 1-3V at 25□ indicated that TiO2 and LTO were delivered a specific capacity over 200 mAh g^{-1} and 174 mAh g^{-1}, respectively.