The study of lithium intercalation and deintercalation properties in TiO_2 nanoparticles

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The demand for high capacity of lithium rechargeable batteries has stimulated the search for use in high power mobile electronic devices. The Lithium ion battery has been developed with $LiCoO_2$, $LiMn_2O_4$, and V_2O_5 as cathode materials and graphite as an anode material. In the anode materials, to avoid graphite drawbacks, transition metal oxides (SnO_2, WO_3, TiO_2 etc.) have been studied. Titanium oxide (TiO_2) represents one of promising anode materials for use in lithium rechargeable batteries, instead of graphite. The TiO_2 has a higher volumetric capacity (1307 mAh/cm^3) than that of graphite (837 mAh/cm ^{3}).[1, 2]

Our research focused on the synthesis and characterization of intercalation oxide such as TiO_2.[3] The object of the present study is to investigate the electrochemical behavior of TiO_2 nanoparticles with three different nanoparticles. 7 nm , 14 nm and 30 nm sized TiO_2 nanoparticles were synthesized by a hydrolysis method and were analyzed using X-ray diffraction(XRD), transmission electron microscopy, X-ray photoelectron and Raman spectroscopy. The cells were fabricated with TiO_2 electrode, metallic Li anodes, and polyprolylene separators in a glovebox filled with Ar gas. An 1 M $LiPF_6$ in EC:DEC(1:1) was used as the electrolyte. The electrochemical behavior of the TiO_2 with three different nanoparticle sizes was investigated by cyclic voltammetry, cycler, and a.c. impedance spectroscopy. The intercalation and deintercalation properties were compared with three different TiO_2 (7 nm, 14 nm and 30 nm) samples. Different mechanisms were appeared for the three types of the samples, indicating that particle size had a significant influence on the intercalation/deintercalation properties.

Typical XRD of synthesized three different TiO_2 nanoparticles by the hydrolysis method is given in Figure 1. Mechanism of three different TiO_2 nanoparticles will be discussed in detail.

References

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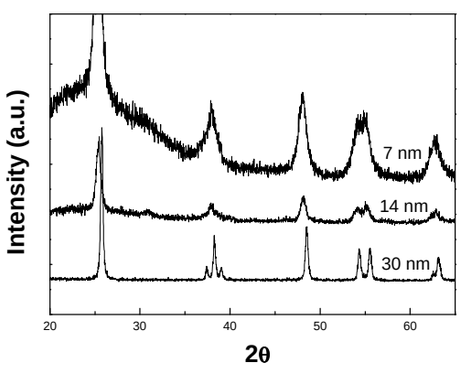

Figure1. XRD Patterns of three different TiO_2 nanoparticles