Title : Sonochemical Synthesis TiO_2(B) Quantum Dots for Use as Anode Material in Lithium-ion Battery.

Author(s) : **1.** Ms. Pornthida Yanapat **Student ID :** 640510146

Major : Industrial Chemistry

Advisor(s) : **1.** Assistant Professor Yothin Chimupala

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ABSTRACT

This research developed sonochemical synthesis methods for titanium dioxide bronze phase (TiO_2(B)) quantum dots for use as an anode material in lithium-ion batteries. The synthesis was conducted using a hydrothermal process at 220°C for 120 hours and 12 hours, followed by an ion exchange process and calcination at 450°C for 5 hours, resulting in TiO_2(B) nanorods. TiO_2(B) quantum dots were then synthesized using ultrasonic waves with suspension of TiO_2(B) nanorods in the water at amplitudes of 100 and 21 for durations of 5, 10, 15, and 60 minutes. This study investigated the influence of hydrothermal process duration on the characteristics and size of the TiO_2(B), as well as the effects of ultrasonic wave amplitude and duration on particle size. Additionally, the impact of particle size on lithium-ion battery performance was examined. The TiO_2(B) quantum dots were characterized using Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), and X-ray Diffraction (XRD) analysis. The results from hydrothermal synthesis demonstrated the successful preparation of TiO_2(B) particles, which exhibited a long rod-like morphology. A hydrothermal duration of 120 hours produced particles with an average length of approximately 1329 nm and a width of about 192.71 nm, while a 12-hour hydrothermal process yielded particles with an average length of about 994 nm and a width of about 208 nm. It was observed that longer hydrothermal durations resulted in longer and narrower particles. When the particles were subjected to ultrasonic wave irradiation, the study found that ultrasonic waves did not alter the crystal

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structure (still be TiO_2(B)) but did strong influence on particle size. Particles treated with ultrasonic waves at an amplitude of 100 for 15 minutes had an average length of 565 nm and a width of 172 nm, indicating that increased amplitude and duration led to smaller particle sizes. The impact of particle size on battery performance was evaluated using NEWARE battery testing equipment, which revealed that the smallest particles exhibited the highest specific capacity of 311.62 mAh/g at 70 cycles which is higher than the results from the non-sociated TiO_2(B) materials .

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