

Electrochemical Study of Mesoporous Core-shell Lithium Titanate-Carbon Composite ($\text{Li}_4\text{Ti}_5\text{O}_{12}$ -Carbon) with Controlled Microstructure as Anode in Lithium Ion Batteries for Wide Temperature Range

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Integrate carbon and lithium titanate ($\text{Li}_4\text{Ti}_5\text{O}_{12}$) with appropriate structure control would enhance the rate performance of $\text{Li}_4\text{Ti}_5\text{O}_{12}$ as anode with improved electronic conductivity.[1-4] In this study, carbon with hollow core and mesoporous shells of controlled dimensions (in terms of diameter of core, thickness of the shell and diameter of the mesopores) were synthesized via silica hard-template method. $\text{Li}_4\text{Ti}_5\text{O}_{12}$ -carbon composites were built through impregnation of $\text{Li}_4\text{Ti}_5\text{O}_{12}$ into the core-shell carbon. Cross-section TEM studies have been performed and proved that $\text{Li}_4\text{Ti}_5\text{O}_{12}$ particles are impregnated within the mesoporous carbon shell structure.

These $\text{Li}_4\text{Ti}_5\text{O}_{12}$ -carbon composites demonstrate higher electronic conductivity, and enhanced electrochemical behavior for prolonged cycles at high discharge rate due to increased surface area of the active material, and improved ion transport pathways from possibly the length scale effect. The Coulombic efficiency can achieve 98% and 96%, and superior long cycle life with high retention of 99% and 85% over 2000 cycles at 10C (2.2 A/g) and 20C (4.4 A/g), respectively. Outstanding electrochemical behavior is also observed for low temperature condition.

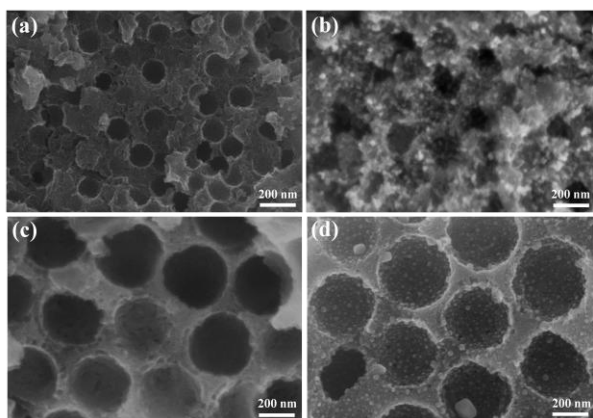


Fig. 1 SEM micrographs of HCMS carbon with shell thickness of ca. 50 nm and core diameter of (a) 150 nm (C-150) and (c) 350 nm (C-350); $\text{Li}_4\text{Ti}_5\text{O}_{12}$ /carbon nanocomposite using (b) C-150 as substrate (LTO/C-150) and (d) C-350 as substrate (LTO/C-350).

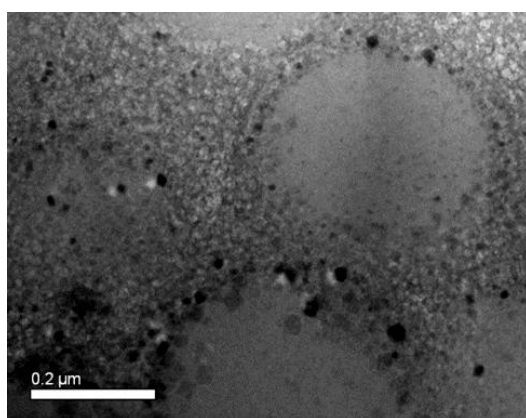


Fig. 2. Cross-sectional TEM image of $\text{Li}_4\text{Ti}_5\text{O}_{12}$ /carbon nanocomposite.

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References

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