

# Electrochemical Characteristics of Nano-size $\text{Li}_4\text{Ti}_5\text{O}_{12}/\text{C}$ as Anode Materials of Lithium-ion Battery

Byung-Ki Na\*, Sang-Baek Kim

Department of Chemical Engineering, Chungbuk National University, Chungdaero 1, Seowongu, Cheongju, 362-763, Korea  
[nabk@chungbuk.ac.kr](mailto:nabk@chungbuk.ac.kr)

## Abstract

Lithium ion battery has been extensively used to mobile electronics, electric vehicle, and energy storage system. In order to increase the energy density many research have been studied for the development of cathode, anode, and electrolyte.  $\text{Li}_4\text{Ti}_5\text{O}_{12}$  can be used as the anode material. Lithium titanium oxide has a spinel-type structure and has unique insertion-deinsertion mechanism. It is "zero-strain" insertion material and long cycle life and excellent cycle characteristics. Theoretical capacity of  $\text{Li}_4\text{Ti}_5\text{O}_{12}$  is 175 mAh/g. Formal potential of Li insertion is approximately 1.55 V ( $\text{Li}^+$  vs. Li). Carbon is regarded as an ideal conductive additive since carbon-based materials (CNTs, graphene) have superior electrical conductivity.

$\text{Li}_2\text{Co}_3$ ,  $\text{TiO}_2$ , CNT, and graphene were mixed with planetary ball mill. The mixture was dried at  $80^\circ\text{C}$  for 6h and calcined at  $800^\circ\text{C}$  for 6h. It was heat-treated at  $700^\circ\text{C}$  for 12h under propylene flow condition.

Carbon-coated  $\text{Li}_4\text{Ti}_5\text{O}_{12}$  synthesized via a simple solid-state reaction (CNTs and graphene) and a vapor-state reaction (propylene gas). Different types of carbons were added to the precursor mixture to synthesize  $\text{Li}_4\text{Ti}_5\text{O}_{12}$  and showed improved discharge/charge and cycling properties. Graphene-embedded LTO has best performance 178.5 mAh/g at 0.1C and capacity recovery percentage was larger than 98%.

## References

- [1] K.M. Colbow, J.R. Dahn, and R.R. Haering, *J. Power Sources*, 26 (1989) 397.
- [2] K. Zaghib, M. Armand, and M. Gauthier, *J. Electrochem. Soc.*, 145 (1998) 3135.
- [3] S.W. Woo and K.D.K. Kanamura, *Electrochim. Acta*, 53 (2007) 79.

## Figures

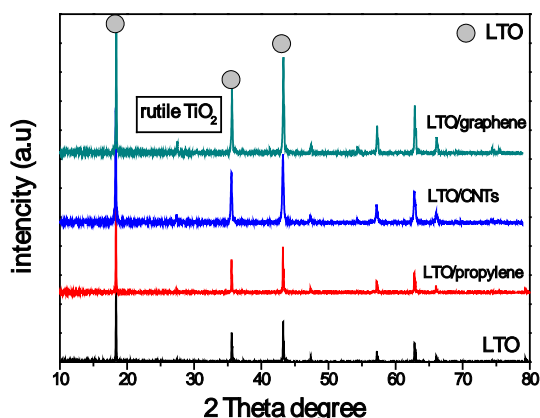


Fig. 1. XRD patterns of  $\text{Li}_4\text{Ti}_5\text{O}_{12}$ ,  $\text{Li}_4\text{Ti}_5\text{O}_{12}/\text{Propylene}$ ,  $\text{Li}_4\text{Ti}_5\text{O}_{12}/\text{CNTs}$ ,  $\text{Li}_4\text{Ti}_5\text{O}_{12}/\text{graphene}$

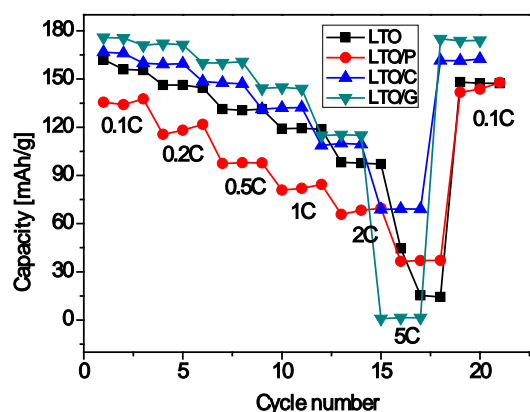


Fig. 2. Cycle performance of Carbon-coated  $\text{Li}_4\text{Ti}_5\text{O}_{12}$