

One pot synthesis of micrometer-sized spherical $\text{Li}_4\text{Ti}_5\text{O}_{12}$ /reduced graphene oxide as anode material for high-rate lithium ion batteries

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Abstract

Spinel $\text{Li}_4\text{Ti}_5\text{O}_{12}$ has attracted much attention as an anode material for lithium-ion batteries because of its good Li-ion intercalation reversibility and extremely small structural changes during charge-discharge cycling. Despite these advantages, $\text{Li}_4\text{Ti}_5\text{O}_{12}$ is not suitable for commercial use due to its low electronic conductivity ($10^{-13} \text{ S cm}^{-1}$), which leads to poor rate capability.¹ Several effective ways to improve the rate capability of $\text{Li}_4\text{Ti}_5\text{O}_{12}$ have been reported, including reduction of the particle size to the nanoscale, doping Li, Ti, or O sites with small amounts of metal or nonmetal ions, surface modification or carbon coating, and its incorporation into composites with carbonaceous materials.²⁻⁴

Among the various carbonaceous materials, reduced graphene oxide (RGO) or graphene nanosheets has attracted considerable interest as electrode materials for electrochemical energy storage because of their unique properties such as high electronic conductivity, large surface area, and good mechanical properties. Some recent studies have demonstrated the excellent rate capability and cycle stability of $\text{Li}_4\text{Ti}_5\text{O}_{12}$ /RGO nanocomposites.⁴ However, in all these reports, the lithium-titanium-oxide (Li-Ti-O)/RGO nanocomposite as the precursor for $\text{Li}_4\text{Ti}_5\text{O}_{12}$, was initially synthesized using a two-step or multistep process. In such multistep methods, $\text{Li}_4\text{Ti}_5\text{O}_{12}$ particles can be limited the available sizes and morphologies. In addition, it is difficult to fabricate the phase-pure $\text{Li}_4\text{Ti}_5\text{O}_{12}$ due to the formation of titanates with several other phases.⁵

Previously reported $\text{Li}_4\text{Ti}_5\text{O}_{12}$ /RGO nanocomposites mostly have 2-dimension morphologies with low tap density.^{4,5} The 2-dimensional $\text{Li}_4\text{Ti}_5\text{O}_{12}$ /RGO nanocomposites are not suitable for commercial use because their low tap density limits the volumetric energy density. Therefore, a simple and facile synthesis of micrometer-sized spherical $\text{Li}_4\text{Ti}_5\text{O}_{12}$ /RGO composites with a high tap density and superior rate capability is highly desirable.

In this study, we report *one-pot* synthesis of micrometer-sized spherical $\text{Li}_4\text{Ti}_5\text{O}_{12}$ /RGO with high tap density, wherein the initial Li-Ti-O/RGO precursor is fabricated by the spray drying method in the presence of all precursors in a solution. Upon subsequent heat treatment, phase-pure micrometer-sized spherical $\text{Li}_4\text{Ti}_5\text{O}_{12}$ /RGO with high tap density was successfully synthesized. More detailed on the synthetic procedure, morphology, electrochemical and structural properties of micrometer-sized spherical $\text{Li}_4\text{Ti}_5\text{O}_{12}$ /RGO will be presented at the meeting.

References

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Figures

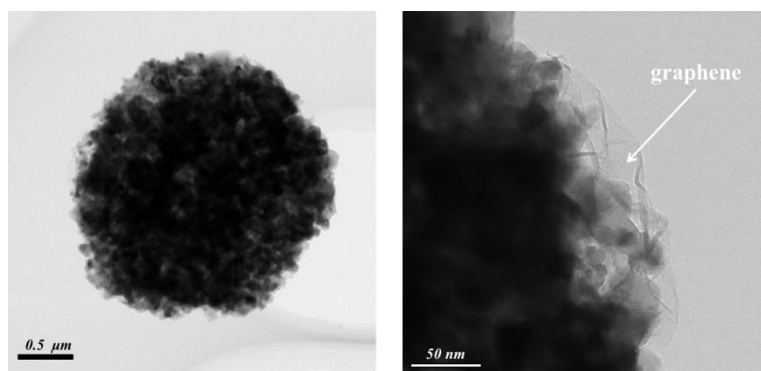


Figure 1 TEM images of micrometer-sized spherical $\text{Li}_4\text{Ti}_5\text{O}_{12}$ /RGO microspheres