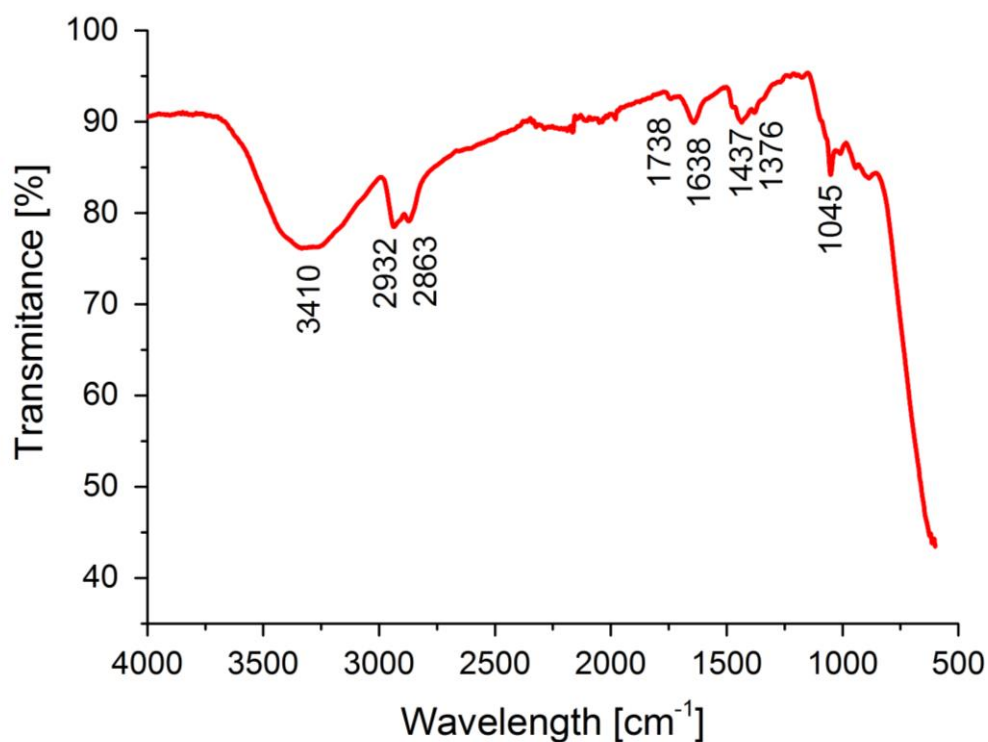
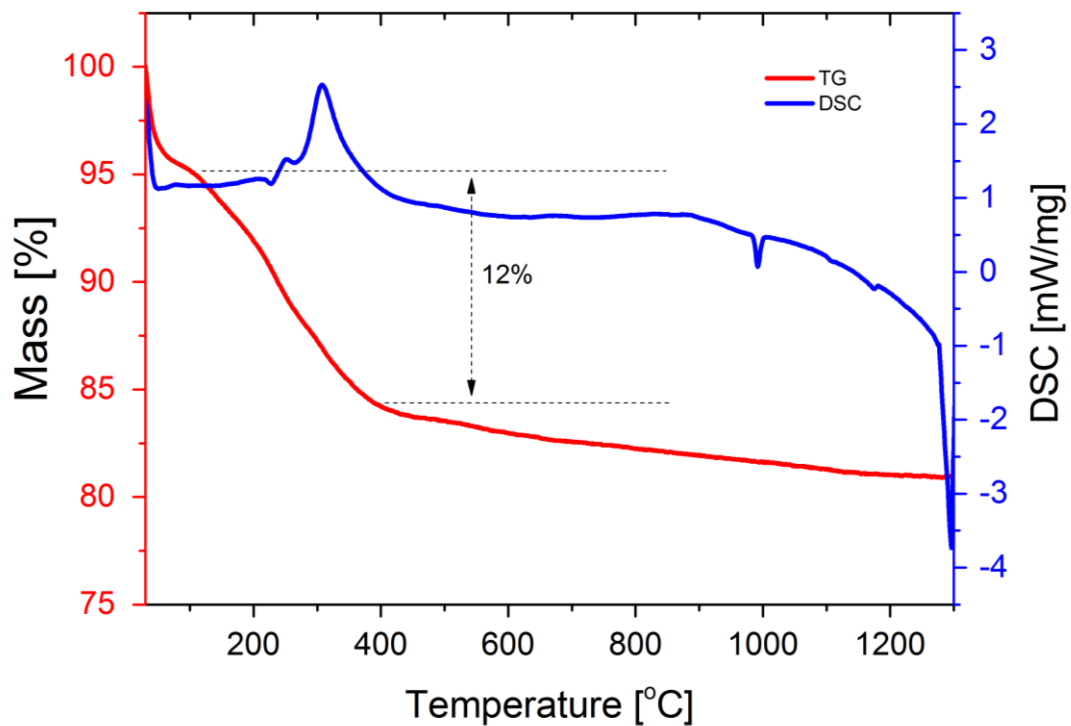


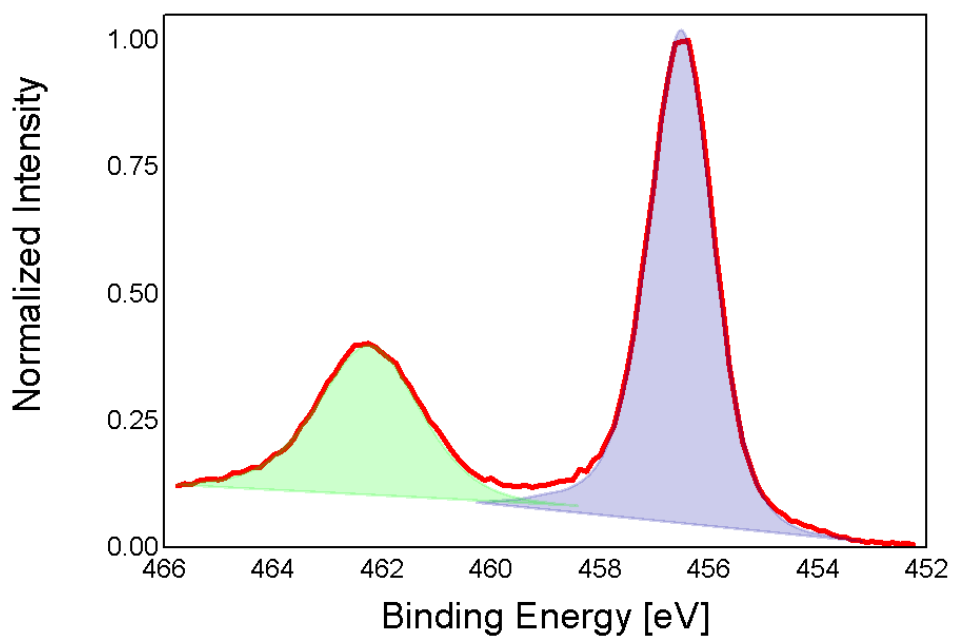
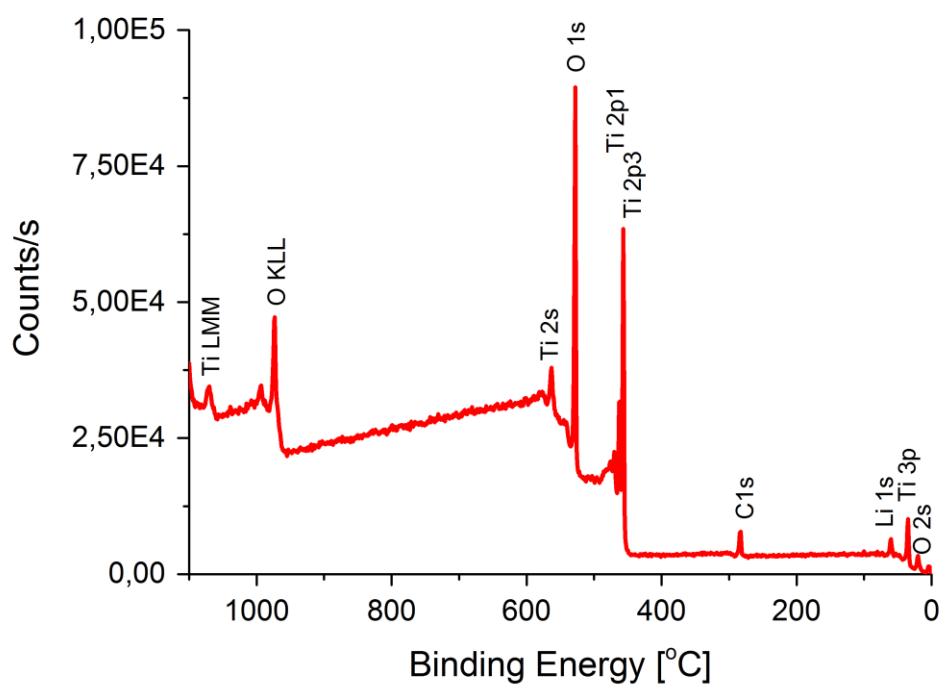
**Supplementary Figure 1** Nitrogen adsorption/desorption isotherms and Barrett-Joyner-Halenda (BJH) pore size distribution (insert) analysis for the as-obtained LTO.



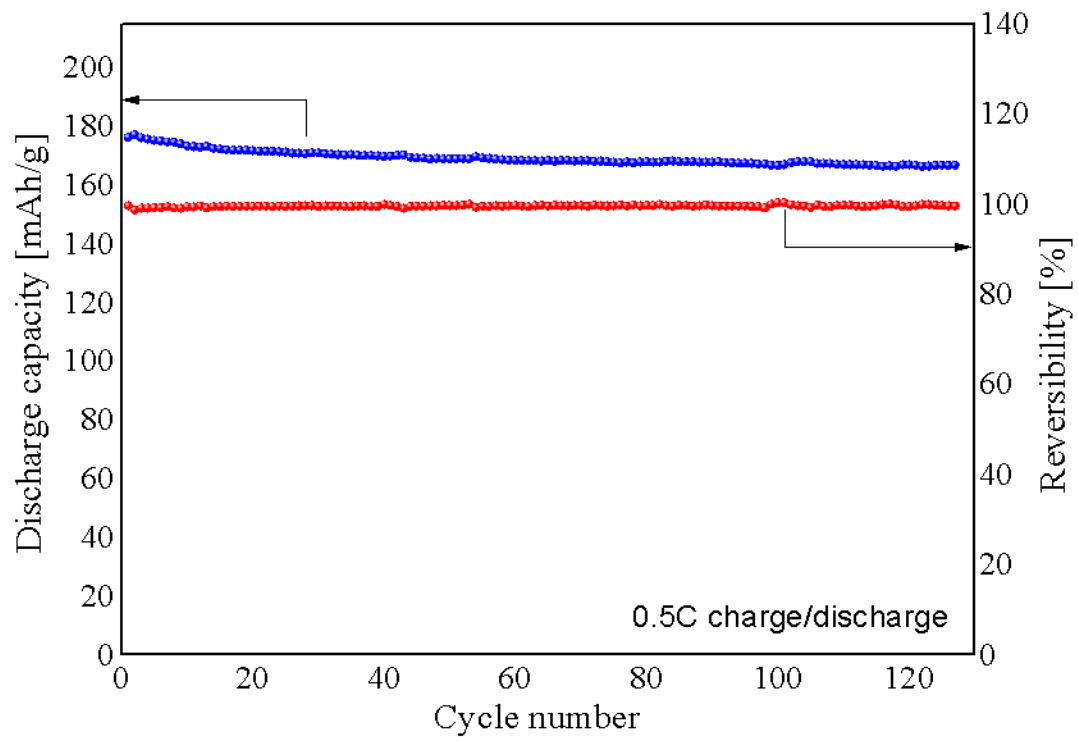
**Supplementary Figure 2** Fourier transform infrared (FT-IR) spectroscopy of obtained LTO. The surface of NPs was examined by means of FTIR. Broad and strong peak with the maximum at 3410 cm<sup>-1</sup> and peak at 1638 cm<sup>-1</sup> correspond to O-H groups at the surface of NPs and adsorbed water. The 2932 cm<sup>-1</sup> and 2863 cm<sup>-1</sup> peaks are due to the asymmetric and symmetric stretching of the methylene groups from butoxy groups and 1,4-BD. Then it was confirmed by the peaks located at 1437, 1376 cm<sup>-1</sup> (wagging modes of methylene groups) and 1045 cm<sup>-1</sup> which is due to stretching of C-O bonds. Peak at 1738 cm<sup>-1</sup> is probably due to some carboxylic group from lithium acetate and it corresponds to C=O stretching. As the conclusion, nanoparticles are mostly covered with 1,4-butanediol and butoxy groups, which are not completely removed during washing step. This shows that 1,4-BD serve as capping agents preventing further growth of particles.



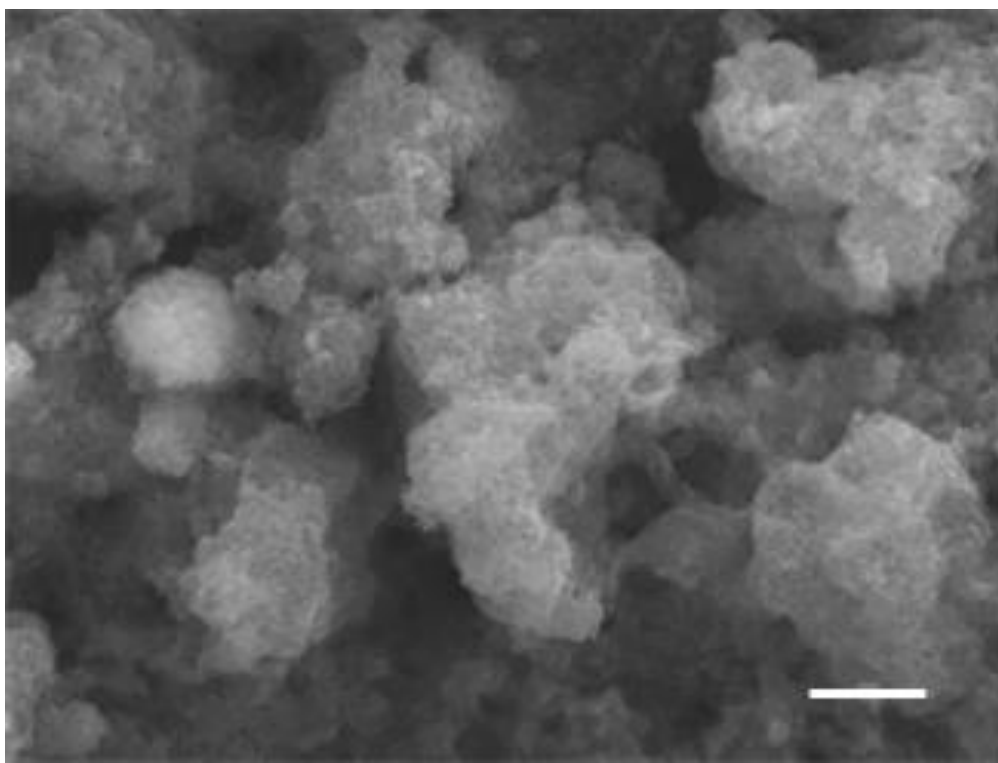
**Supplementary Figure 3** Thermal gravimetric analysis and differential scanning calorimetry of as-obtained LTO. The amount of adsorbed organics was evaluated by thermal analysis. Up to around 1200°C, adsorbed water is removed from the nanoparticles. Then gradually –OH groups and organic species are removed from the surface (exothermic peaks at 251 and 307°C).



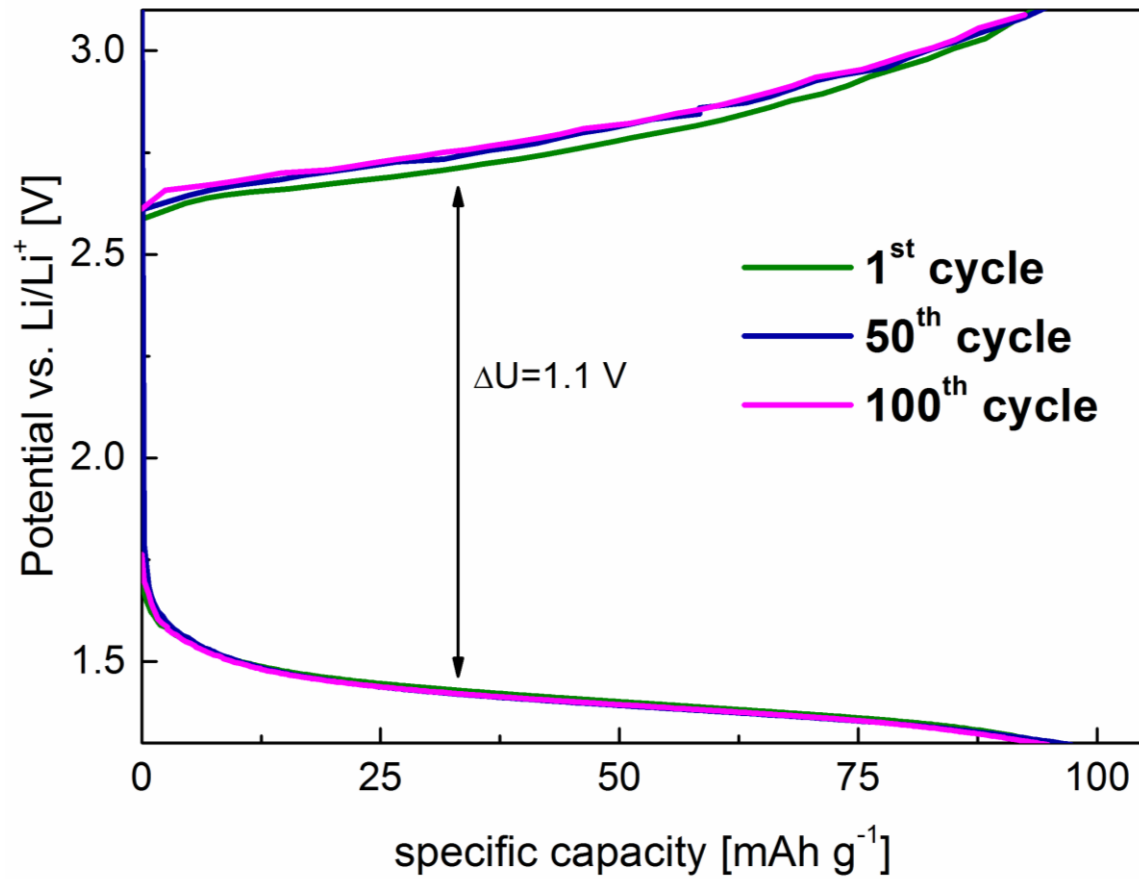
**Supplementary Figure 4.** XPS spectra (**upper**) and Ti2p XPS spectra (**bottom**) of hierarchically nanostructured LTO.



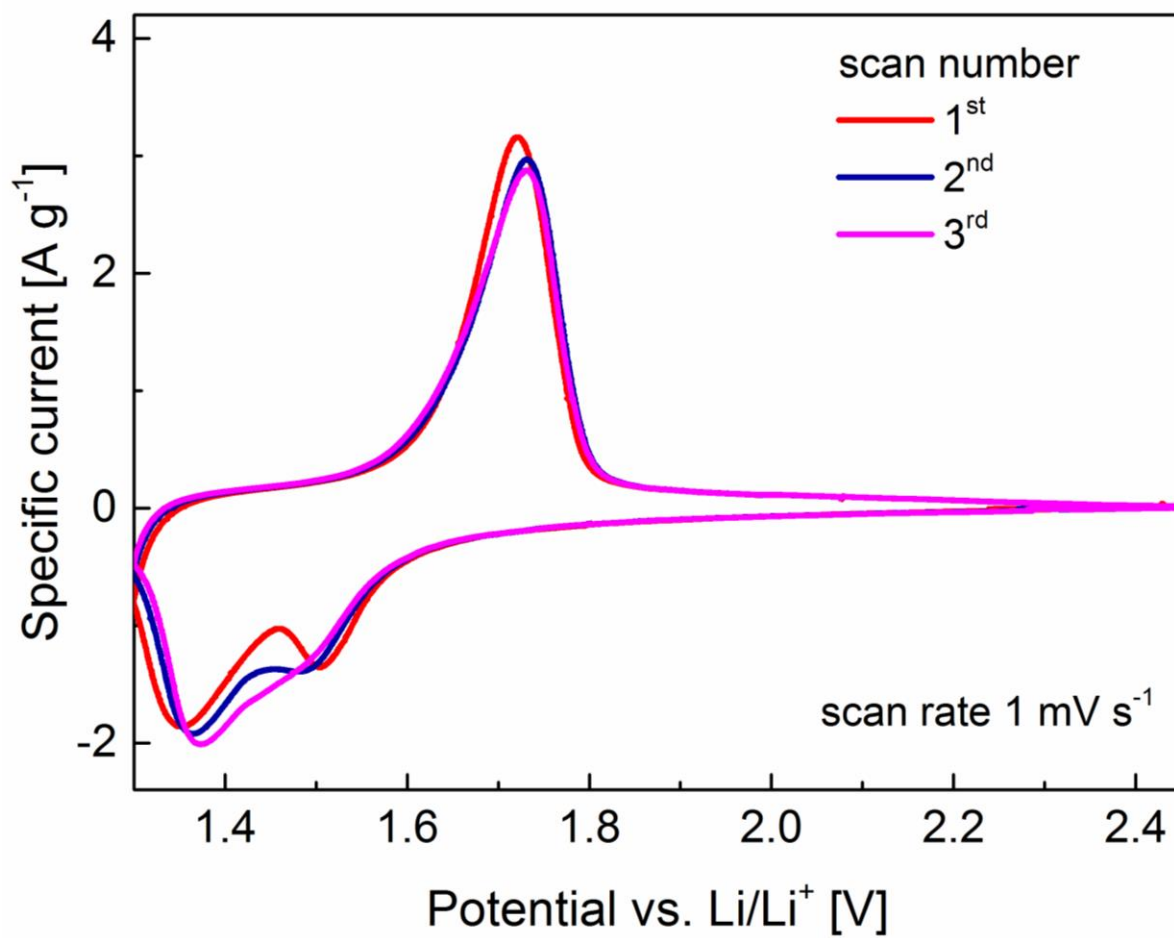
**Supplementary Figure 5.** Initial 120 cycles of Li/Li<sup>+</sup>/LTO battery at 0,5 C current rate.



**Supplementary Figure 6.** SEM picture of anode layer prepared from LTO and cycled 300 times at 50C. Scale bar, 1 $\mu$ m.

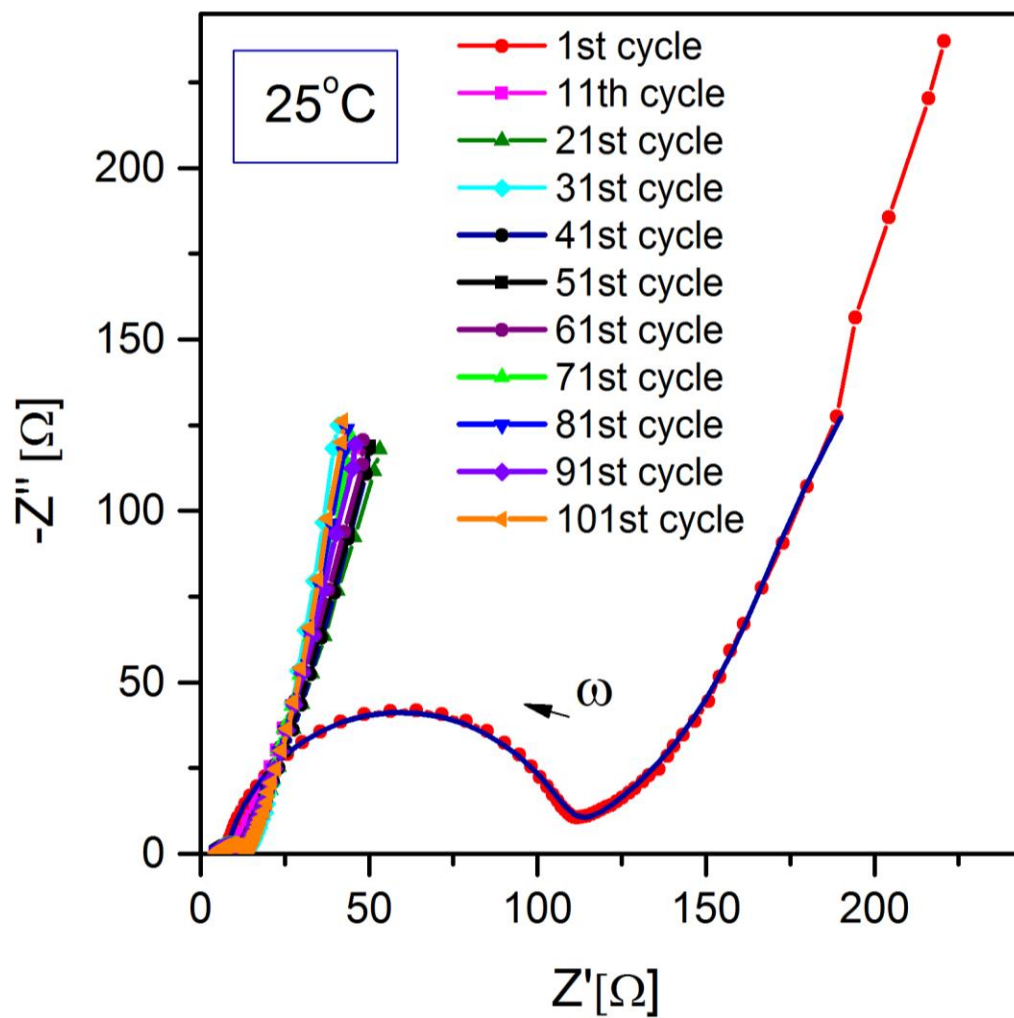


**Supplementary Figure 7.** Selected charge/discharge profiles for Li/Li<sup>+</sup>/LTO battery charged at 500 C and discharged at 50 C current rate.



**Supplementary Figure 8.** Results of cycling voltammetry studies of Li/Li<sup>+</sup>/LTO battery performed with 1 mV s<sup>-1</sup> scanning rate.





Supplementary Figure 9. EIS data on cycling, recorded for Li/Li<sup>+</sup>/LTO cell.

**Supplementary Table 1** Atomic composition of as-obtained LTO calculated from XPS results.

	<b>C</b>	<b>O</b>	<b>Ti</b>	<b>Li</b>	<b>Li/Ti</b>	<b>O/(Li+Ti)</b>
<b>LTO 1<sup>st</sup></b>	11.7	58.0	20.4	9.9	0.49	1.91
<b>LTO 2<sup>nd</sup></b>	10.7	58.2	20.8	10.3	0.50	1.87