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CTCI Science and Technology Research Scholarship

High performance lithium titanate oxide for Li ion batteries

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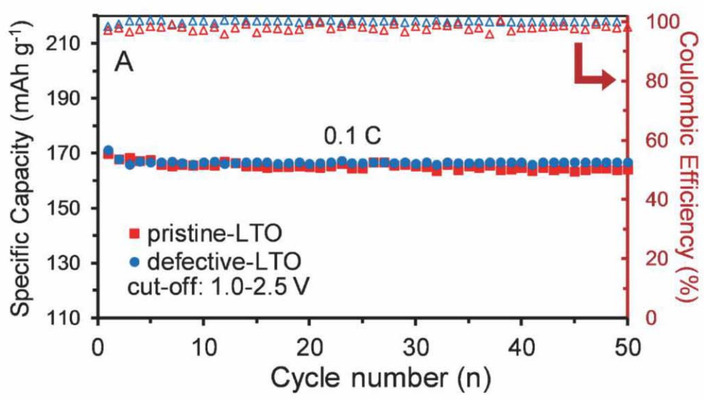
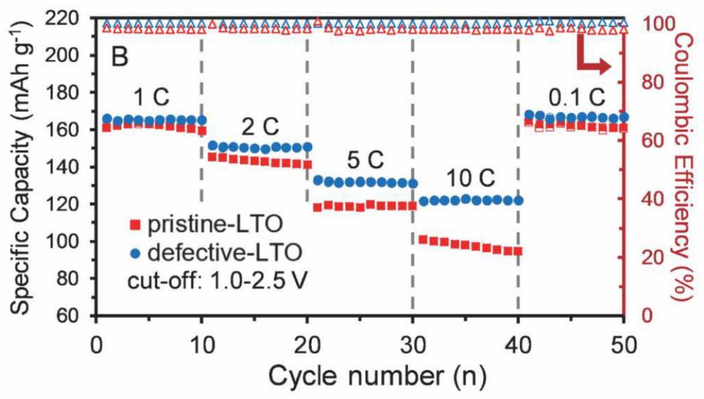
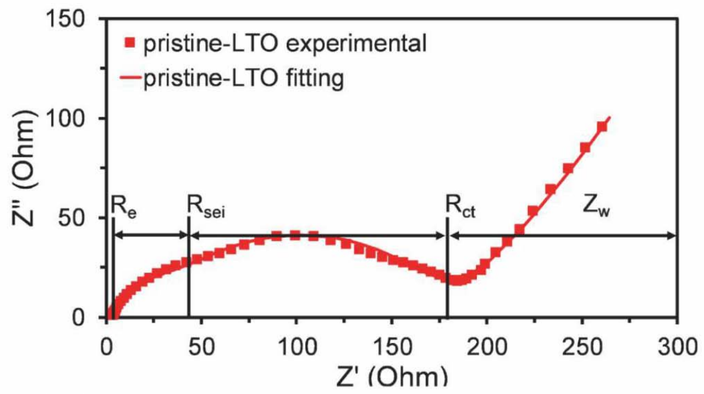
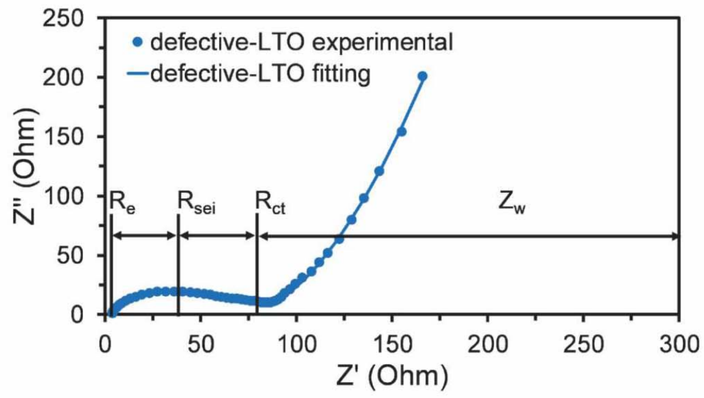
Electrochemical Performance





Cycling performance of pristine and defective-LTO at C/10 rate (17 mA/g) and at multiple C-rates

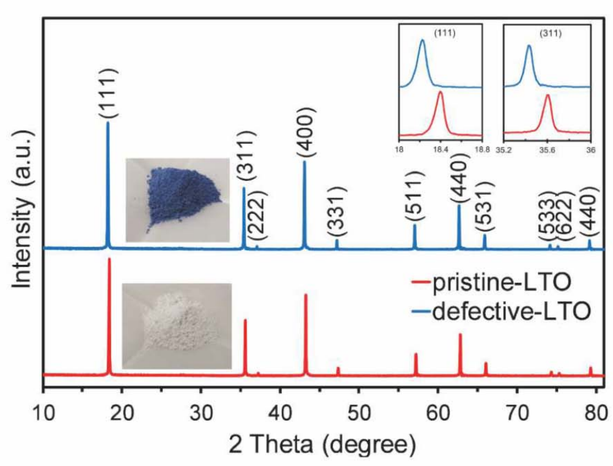




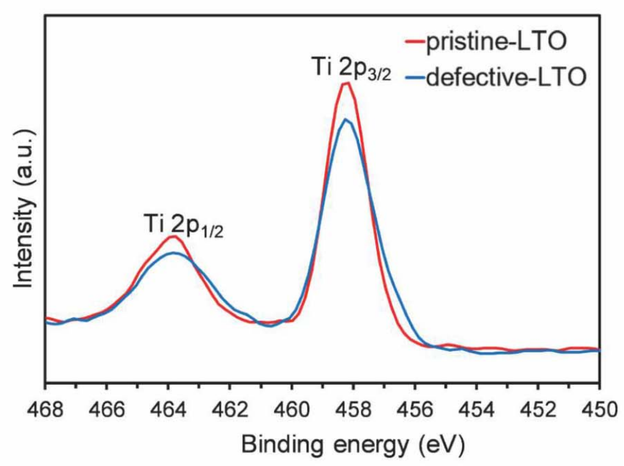
Nyquists plot of pristine and defective-LTO

The anode electrodes were prepared by mixing LTO powder, conductive carbon black (Super-P), and polyvinylidene fluoride (PVDF) as a binder with the weight ratios 80:10:10. Nonwoven fabric was used as the separator, 1 mol/L $LiPF_6$ dissolved into 1:1 weight ratio of EC and DEC and pure lithium foil was used as the counter electrode.

General Characterization



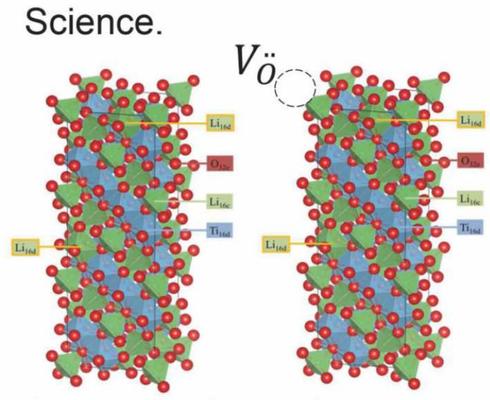
XRD spectra for pristine and defective-LTO, magnified spectra are inset



High-resolution XPS spectra of pristine and defective-LTO of Ti 2p core levels

Research Motivation

Our research stems from novel and cheap energy storage system. We acknowledge that there is a current manufacturing gap, and we try to address those by utilizing a full understanding of Materials Science.



One pot process with the most economic precursors

Heated to 800°C for 8 hours

Conclusions

- Novel synthesis and understanding of a one-pot, facile and cheap thermal reduction
- Synthesized highly defective LTO which delivered 130 mAh g^{-1} with no capacity fading at 10 C-Rate
- Characterization shows increase in Ti^{3+} / Ti^{4+} mixing in the surface and sub-surface, a slightly enlarged lattice opens up the Li diffusion channels
- Better reversibility and superior rate capability due to faster reaction kinetics, enhanced charge-transfer resistance (Key role), better electrode polarization

- Novel Experimental & Theoretical Group for Materials Design(NEXT-G)
- Ongoing Project整合第一原理計算及改良式RAPET製程於鈦酸鋰缺陷尖晶石鋰離子電池奈米電極材料開發 - MOST 105-2221-E-006 -189 -MY3
- Patent pending

References

Tsai, Ping-chun, Wen-Dung Hsu, and Shih-kang Lin. "Atomistic structure and ab initio electrochemical properties of Li4Ti5O12 defect spinel for Li ion batteries." *Journal of The Electrochemical Society* 161.3 (2014): A439-A444.

Acknowledgment

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