Supporting Information

Insights into stable layered structure of Li-rich cathode material for Lithium-ion Batteries

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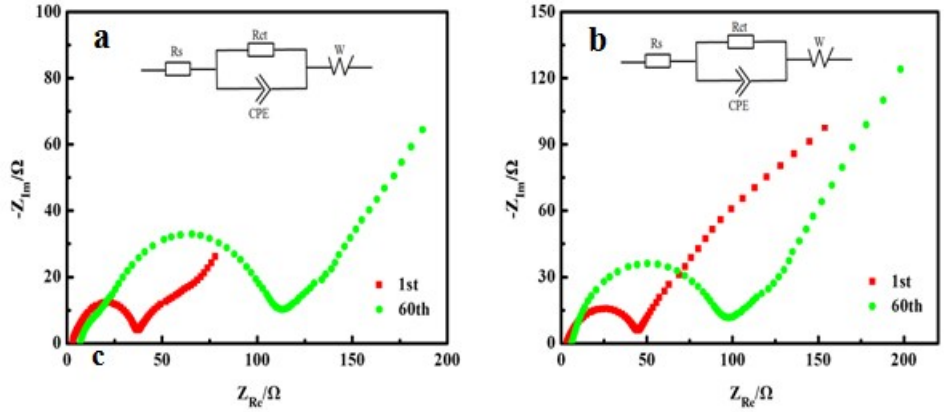

Fig. S1 Electrochemical impedance spectra (EIS) of the $LNMOS_x$ in different cycles at 0.1 C rate . (a) $LNMOS_{0.01}$ (b) $LNMOS_{0.05}$.The insets are enlarged spectra in the high frequency region. EIS were measured in the open circuit mode when discharged to 2.0 V(vs. Li/Li^+).

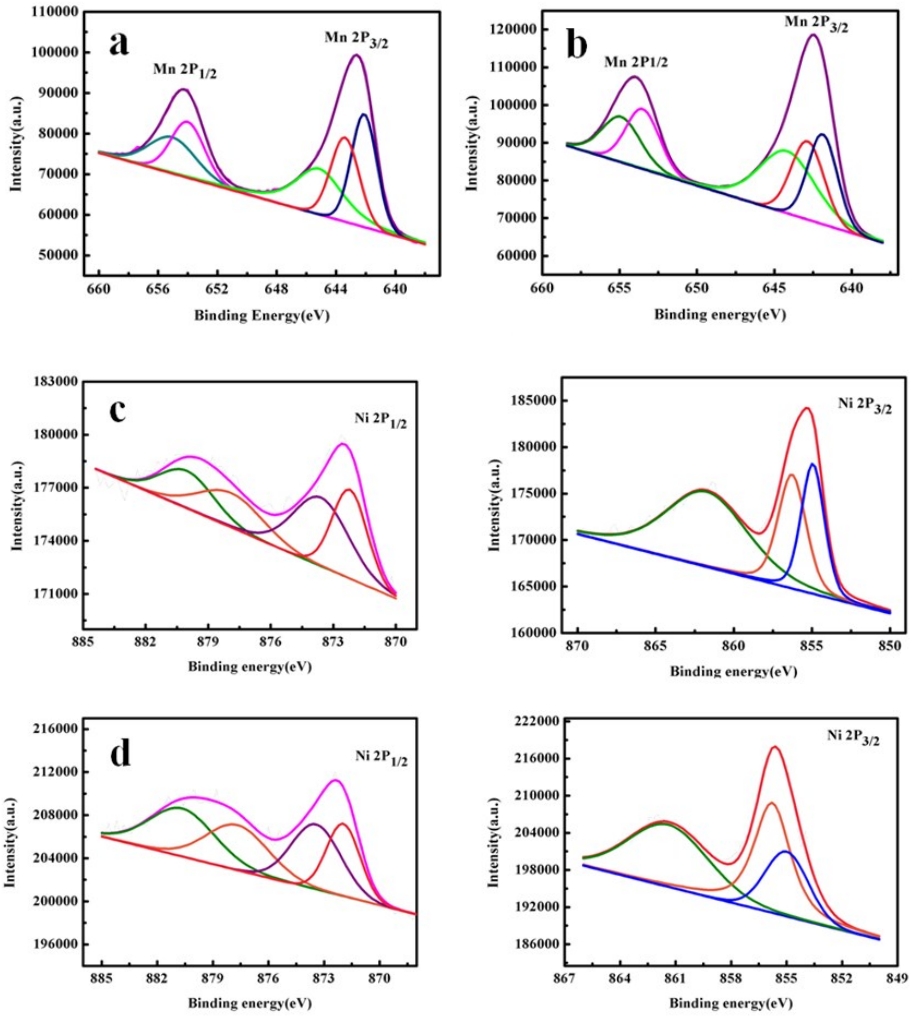

Fig. S2 X-ray Photoelectron Spectroscopy (XPS) of the oxides. Mn 2p of LNMO and $LNMOS_{0.03}$(a and b), Ni 2p of LNMO and $LNMOS_{0.03}$(c and d).

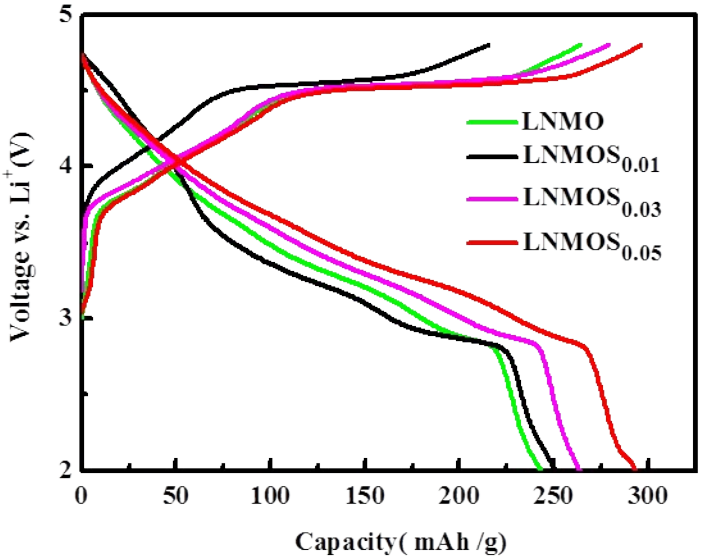

Fig. S3 The charge–discharge curves of the LNMO and LNMIS in the first cycle at 0.1 C rate between 2.0 and 4.8 V (vs. Li/Li^+) at RT.

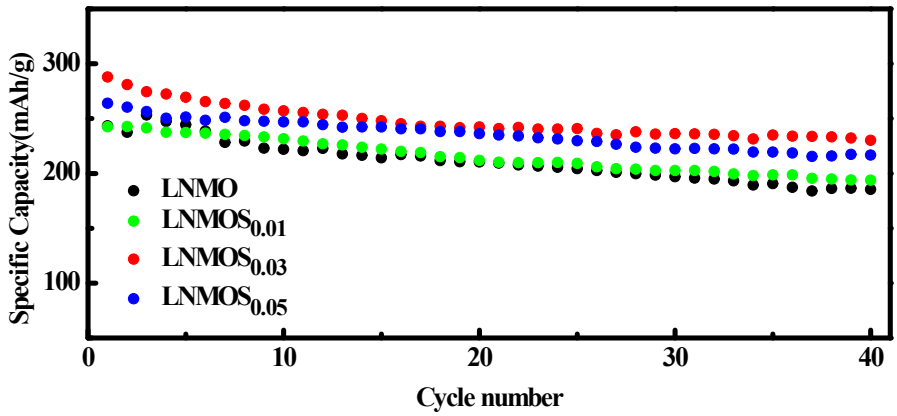

Fig. S4 The cycle performance of the different proportions of sulfur doped LNMO at 0.1 C rate between 2.0 and 4.8 V (vs. Li/Li^+) at RT.

The SEM diagram of the pristine and the sulfur doped sample are shown in Fig. S5. From (a) to (d) can be seen that the samples are showing a spherical morphology. The diameter of the particles is about 200-300nm. It is beneficial for good contact of the electrolyte and electrode materials. The morphology of the particles is not changed by the sulfur doping.

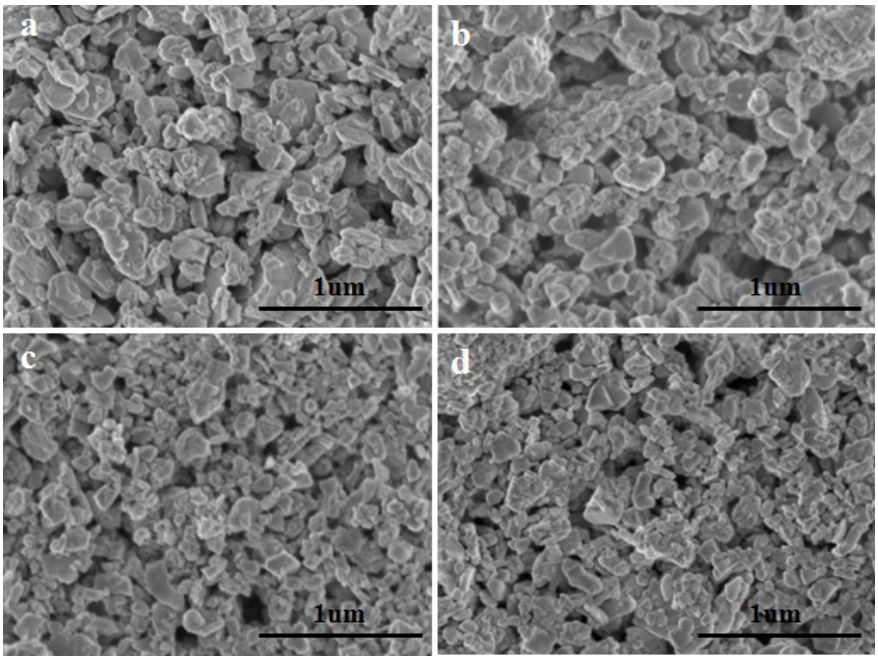

Fig. S5 The SEM images of the oxides. (a) LNMO (b) $LNMOS_{0.01}$ (c) $LNMOS_{0.03}$ and (d) $LNMOS_{0.05}$.

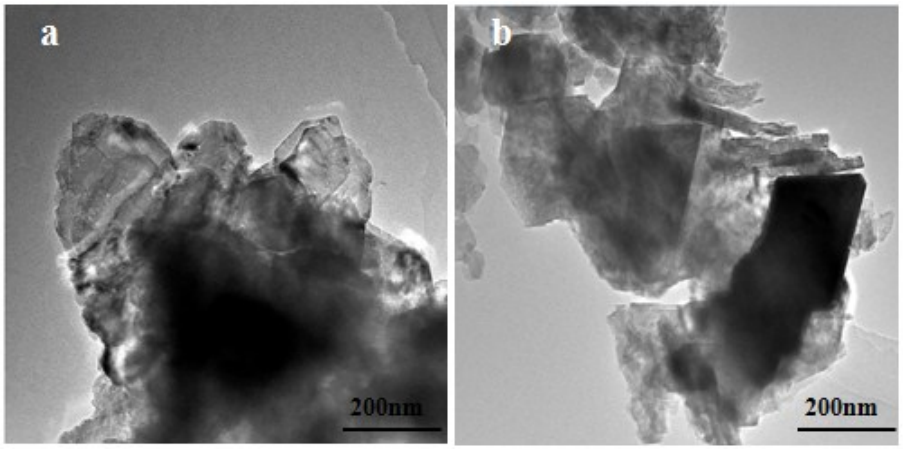

Fig. S6 The TEM images of the rich lithium cathode materials. (a) LNMO at 200 nm, (b) $LNMOS_{0.03}$ at 200 nm

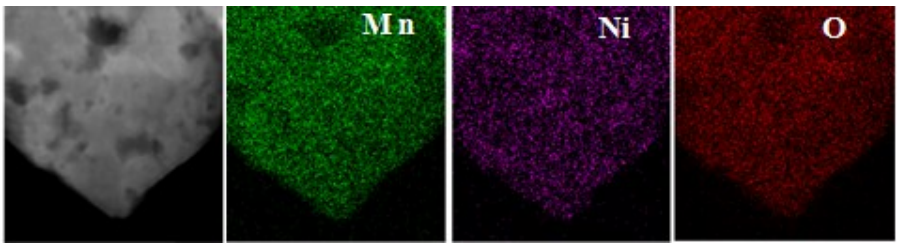

Fig. S7 The TEM images of element mapping for Ni, Mn, O in LNMO sample

References:

[1] Yongqing Wang, Zhenzhong Yang, Yumin Qian, Lin Gu, Haoshen Zhou, *Adv. Mater*. 2015, **27**, 3917.

[2] Pilgun Oh, Seungjun Myeong, Woongrae Cho, Min-Joon Lee, Minseong Ko, Hu Young Jeong, Jaephil Cho, *Nano Lett*. 2014, **14**, 5967.