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Supplementary Information

Nano-$LiNbO_3$ coating layer and diffusion-induced surface control towards high-performance 5-V spinel cathodes for rechargeable batteries

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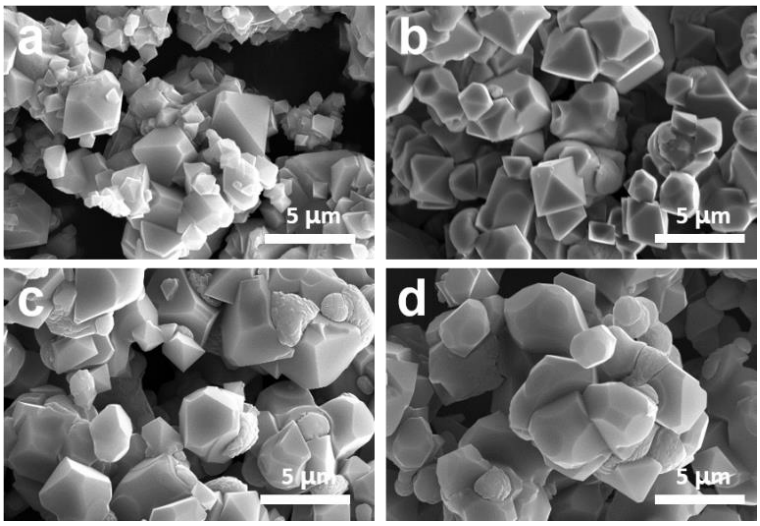

Fig. S1 Field-emission SEM images of (a) pristine $LiNi_{0.5}Mn_{1.5}O_4$, (b) 1 wt.%, (c) 3 wt.% and (d) 5 wt.% $LiNbO_3$-coated $LiNi_{0.5}Mn_{1.5}O_4$.

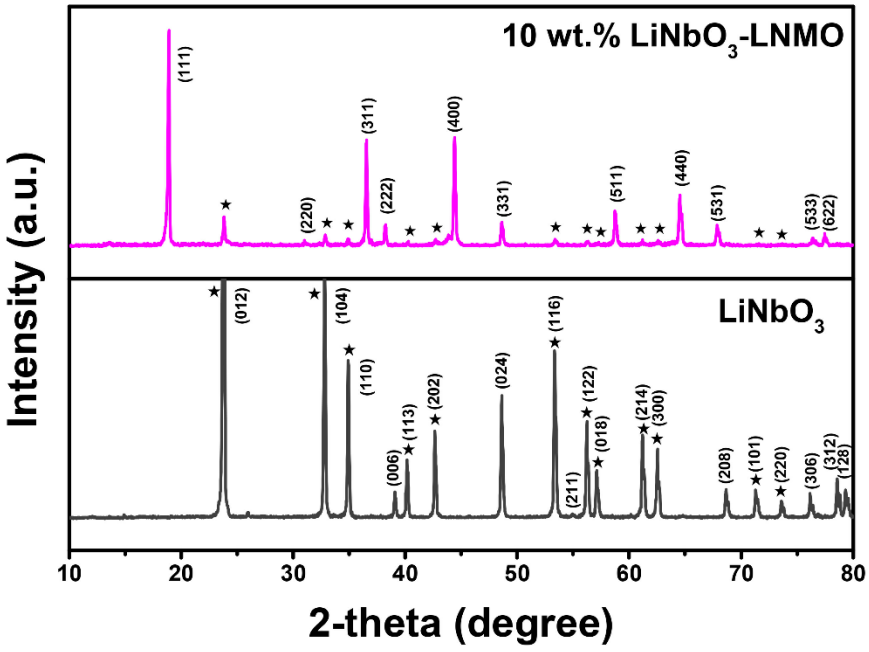

Fig. S2 XRD patterns of the 10 wt.% $LiNbO_3$-coated LNMO and $LiNbO_3$.

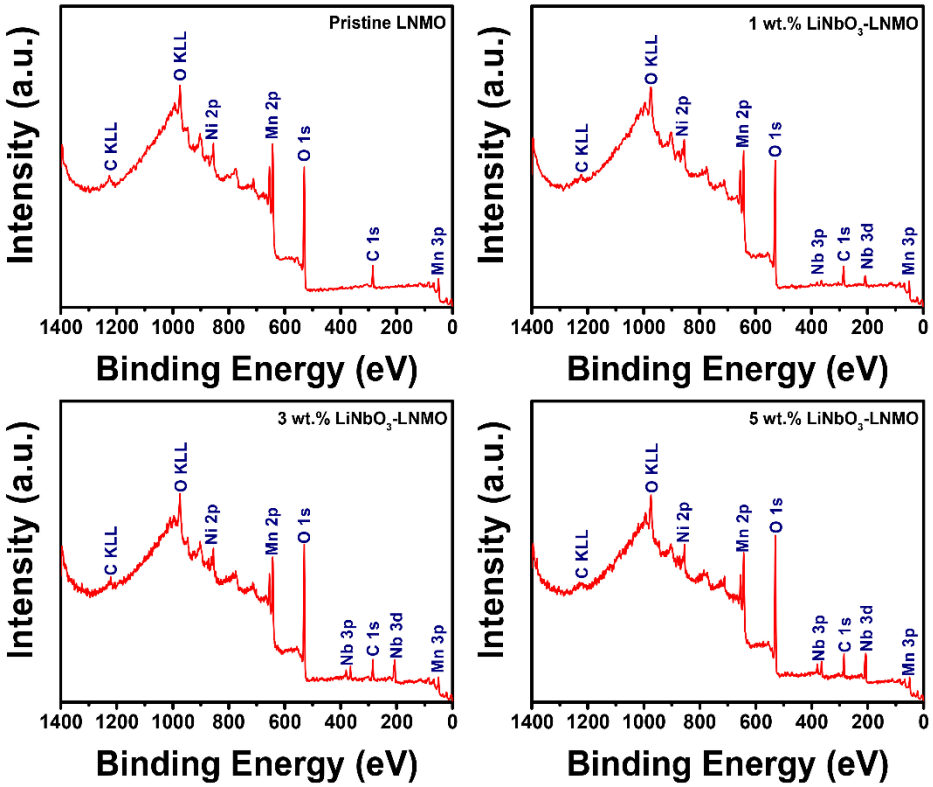

Fig. S3 XPS full-scan spectra of pristine LNMO and various amounts of $LiNbO_3$-coated LNMO.

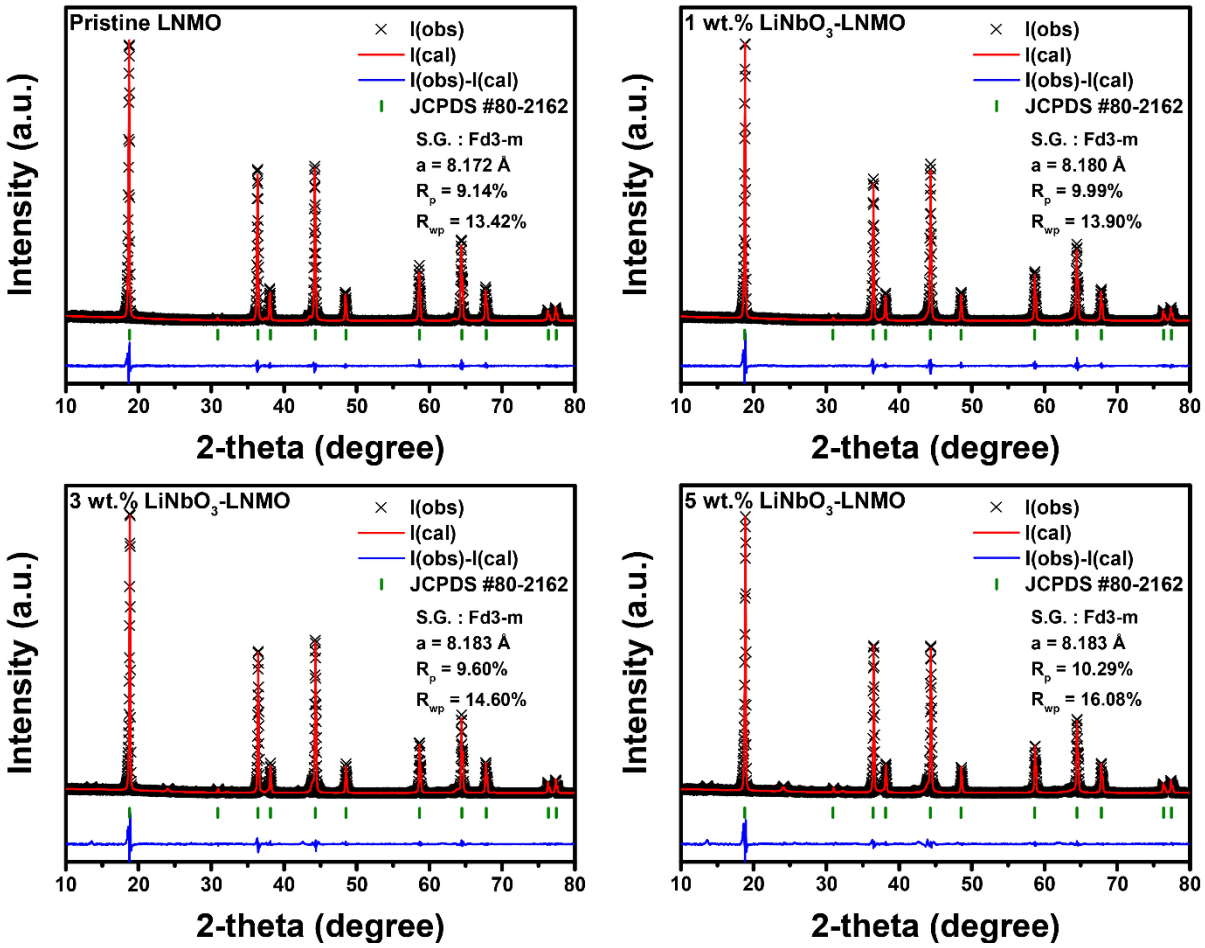

Fig. S4 Rietveld refined XRD patterns of pristine LNMO and various amount of $LiNbO_3$-coated LNMO. The black and red lines represent the experimental and calculated data, respectively. The blue line is the difference curve. The Bragg peak positions of each phase are indicated by the short vertical dark green lines.

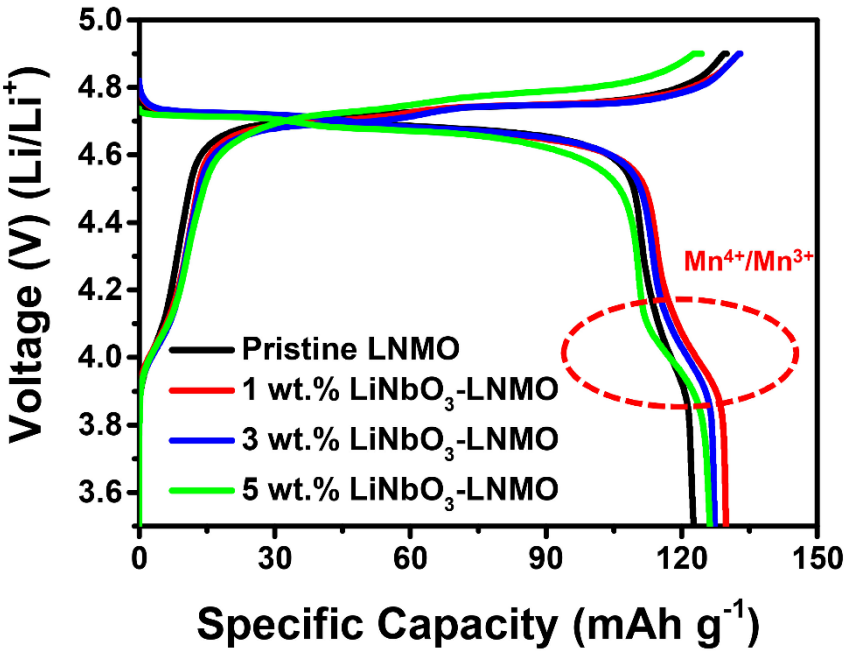

Fig. S5 Initial charge-discharge voltage profiles at 0.1 C of pristine LNMO and various amount of $LiNbO_3$-coated LNMO in the potential range of 3.5–4.9 V (vs. Li/Li^+).

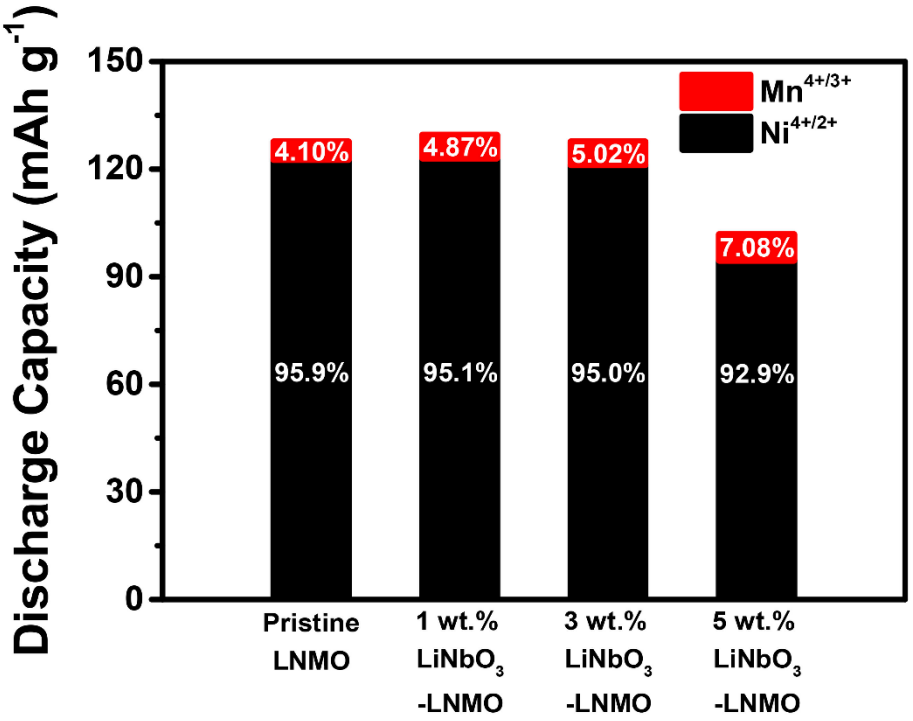

Fig. S6 Discharge capacity contributions of $Ni^{4+}/^{2+}$ and $Mn^{4+}/^{3+}$ calculated from the initial charge-discharge voltage profiles in Fig. S5.

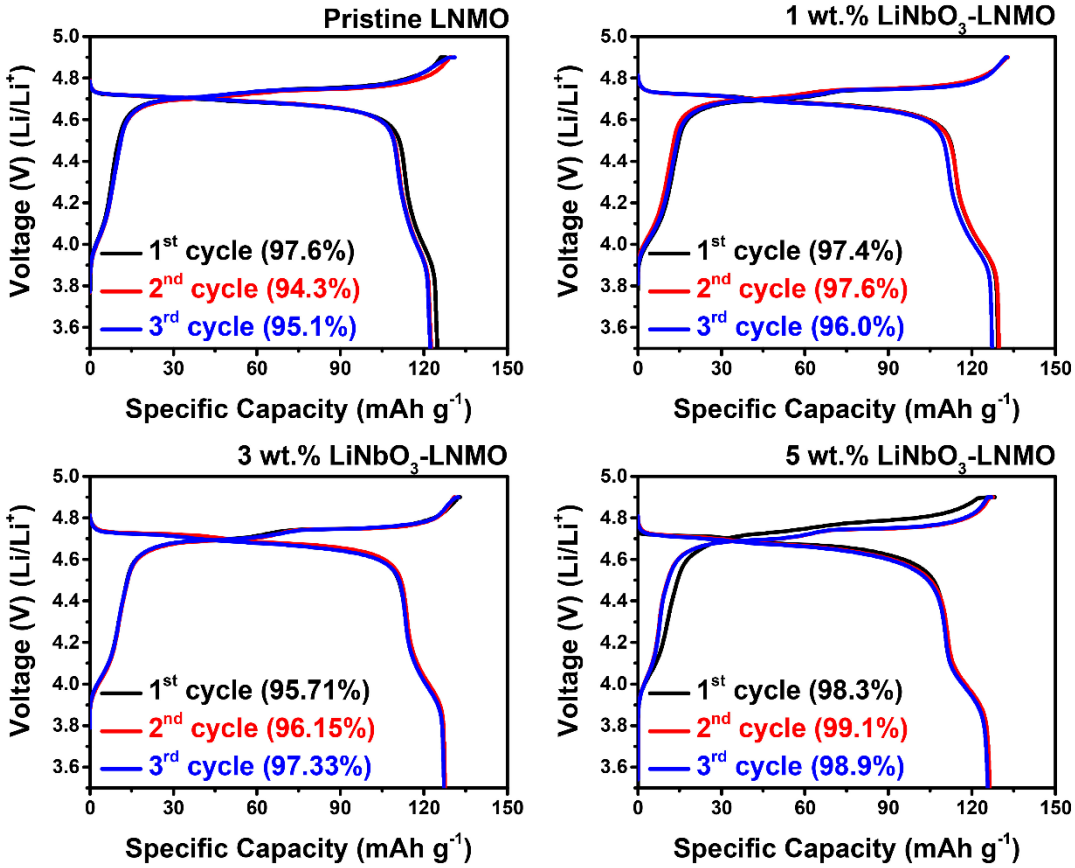

Fig. S7 Charge-discharge voltage profiles with Coulombic efficiency (%) of pristine LNMO and various amount of $LiNbO_3$-coated LNMO for 3 cycles at 0.1 C.

Table S1 Electronic conductivities for the pristine LNMO and various amount of $LiNbO_3$-coated LNMO.

Sample	Conductivity (S cm^{-1})
Pristine LNMO	2.09×10^{-7}
1 wt.% $LiNbO_3$-LNMO	1.35×10^{-6}
3 wt.% $LiNbO_3$-LNMO	1.27×10^{-6}
5 wt.% $LiNbO_3$-LNMO	9.79×10^{-7}

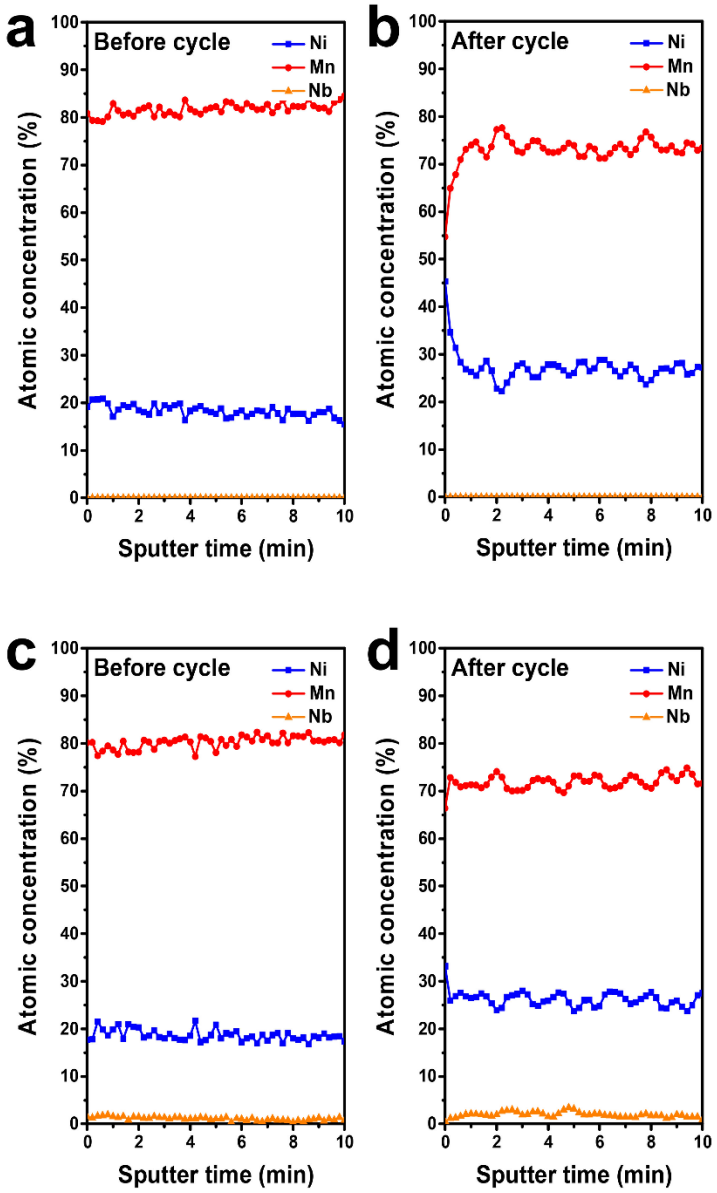

Fig. S8 XPS depth profiles of before and after 100 cycled electrodes at 60℃ for (a,b) pristine $LiNi_{0.5}Mn_{1.5}O_4$ and (c,d) 1 wt.% $LiNbO_3$-coated $LiNi_{0.5}Mn_{1.5}O_4$.

Table S2 The result of inductively coupled plasma optical emission spectrometry (ICP-OES) of Li metal anodes after 100 cycled at 60℃.

Cathode	Deposited Mn on Li metal anode (ppm)
	Mn
Pristine LNMO	183.7
1 wt.% $LiNbO_3$-LNMO	90.17
3 wt.% $LiNbO_3$-LNMO	86.37
5 wt.% $LiNbO_3$-LNMO	46.68