Electronic Supplementary Information

Enhanced electrochemical performance of $Na_{0.5}Ni_{0.25}Mn_{0.75}O_2$ micro-sheets at 3.8 V for Na-ion batteries with nanosized-thin AlF_3 coating

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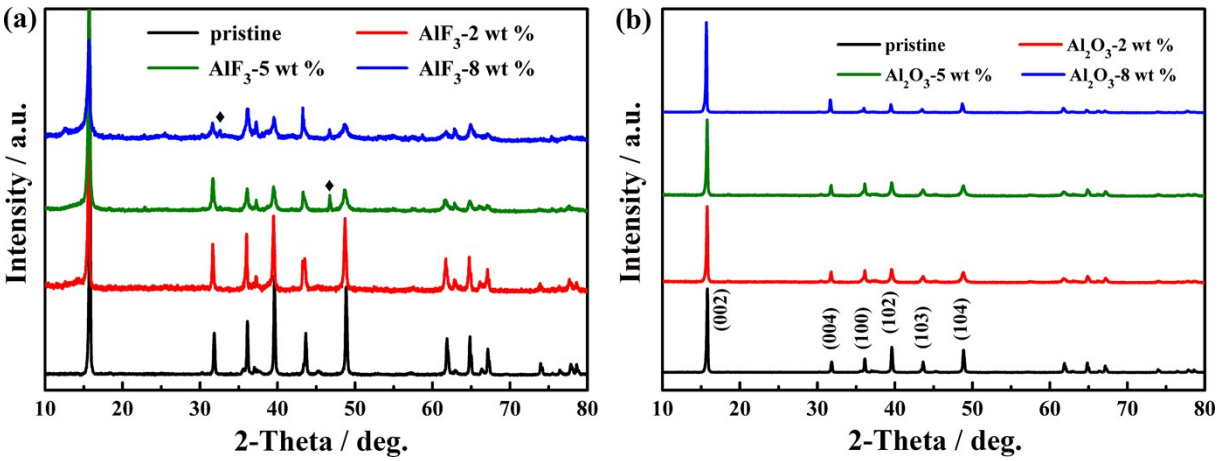

Fig. S1 Powder XRD patterns of NNMO@AlF_3 and NNMO@Al_2O_3 with different coating mount.

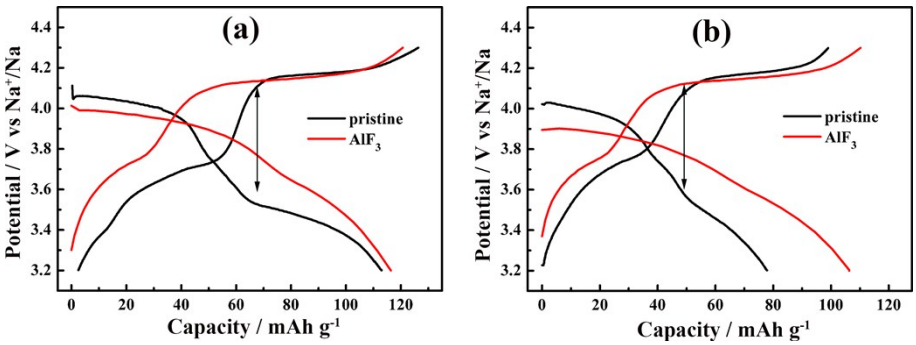

Fig. S2 (a) Typical charge–discharge curves of pristine NNMO and NNMO@AlF_3 at 0.2 C/0.5 C and (b) 0.2 C/1.0 C.

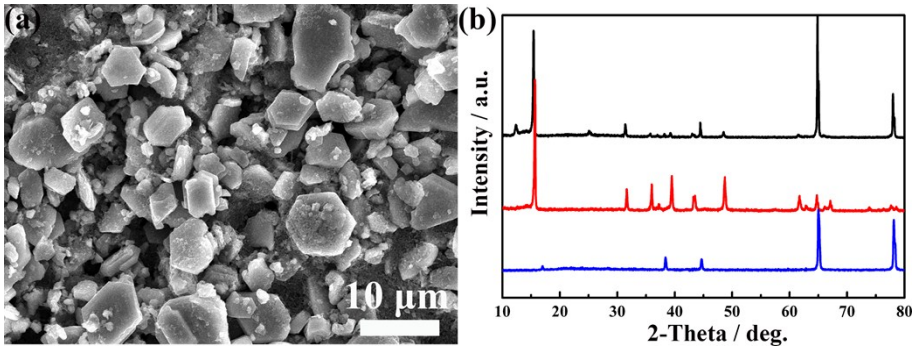

Fig. S3 SEM and XRD of the NNMO@AlF_3 electrode in full discharged state after 100 cycles at 0.2 C rate. In the XRD pattern, the black line (top) indicates the experimental data of cycled NNMO@AlF_3 electrode, red line (middle) is as-prepared NNMO@AlF_3 micro-sheets and blue line (bottom) represents the Al that is the current collector used for the cathode.

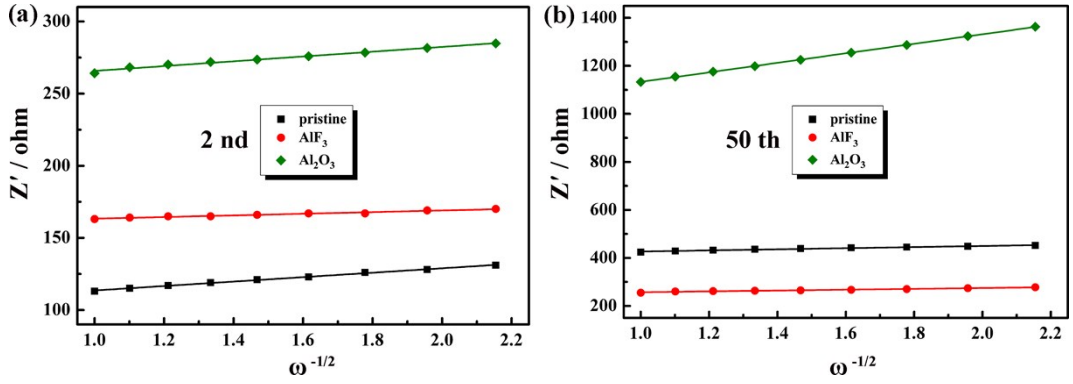

Fig. S4 The relationship between Z′ and $\omega^{-1/2}$ in the low frequency region of EIS collected in

part discharged state at about 4.0 V after different cycles at 0.2 C.

Table S1 The Na^+ diffusion coefficients (D_{Na^+}) of three samples at different cycles.

Samples	pristine NNMO	NNMO@AlF_3	NNMO@Al_2O_3
$D_{Na^+}/cm^2\ s^{-1}$ (2 nd)	6.9×10^{-11}	1.9×10^{-10}	6.4×10^{-11}
$D_{Na^+}/cm^2\ s^{-1}$ (50 th)	4.6×10^{-11}	6.2×10^{-11}	5.4×10^{-12}

Table S2 Electrochemical properties of NNMO@AlF_3 and other current cathode materials.

Materials	**Average Potential**	**Capacity (mAh g^{-1})**	**Capacity retention**	**Reference**
$Na_{2/3}Fe_{1/2}Mn_{1/2}O_2$	2.75 V	190 (13 mA g^{-1}, 1.5−4.2 V)	79 % (13 mA g^{-1}, 30 cycles)	Ref 3
$Na_{0.66}(Mn_{0.54}Co_{0.13}Ni_{0.13})O_2$	3.6 V	121 (1C, 2−4.5 V)	50 % (1C, 100 cycles)	Ref 6
$Na_{2/3}Mn_{0.8}Fe0.1Ti_{0.1}O_2$	2.9 V	99 (1C, 2.0−4.0 V)	87.7 % (1C, 300 cycles)	Ref 14
$Na_{2/3}Ni_{1/3}Mn_{5/9}Al_{1/9}O_2$	3.0 V	137 (0.1 C, 1.6−4.0 V)	89 % (1C, 150 cycles)	Ref 23
$Na_{0.9}Ca_{0.05}Ni_{1/3}Fe_{1/3}Mn_{1/3}O_2$	3.0 V	116 (1C, 2.0−4.0 V)	92 % (1C, 200 cycles)	Ref 25
$Na_3V_{2-x}Ti_x(PO4)_2F_3$	3.6 V	125 (0.2C, 2.0−4.5 V)	81.5 % (1C, 200 cycles)	Ref 26
$Na_{0.5}(Ni_{0.2}Co0.15Mn_{0.65})O_2$	2.4 V	180 (0.1C, 1.5−4.0 V)	87.6 % (0.1C, 100 cycles)	Ref 27
NNMO@AlF_3	3.8 V	121 (0.2C, 3.2−4.3 V)	80 % (0.2C, 100 cycles)	This work