Supplementary Material

A high-entropy layered P2-type cathode with high stability for sodium-ion batteries

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Table S1: The refined parameters of NLNMO and NLNBMMO-5%

	NLNMO	NLNBMMO-5%
a/Å	2.89885	2.91005
b/Å	2.89885	2.91005
c/Å	11.06831	11.11041
V/ $Å^3$	80.54	80.74
R_p (%)	3.22	4.52
R_{wp} (%)	8.07	7.01
Gof	1.57	1.49

Table S2: Comparison of electrochemical performances of NLNMO, NLNBMMO-5% and NLNBMMO-10%

Sample	Initial discharge capacity (mA h g^{-1})	Capacity after cycling (mA h g^{-1})	Capacity retention
NLNMO	89.8 (1 C)	77 (1 C)	85.70%
	69.1 (1 C)	49.6 (5 C)	75.00%
NLNBMMO-5%	102.6 (1 C)	96.6 (1 C)	94.20%
	75.2 (5 C)	61.2 (5 C)	81.40%
NLNBMMO-10%	87.4 (1 C)	81.6 (1 C)	93.30%
	63.4 (5 C)	50.1 (5 C)	78.80%

Table S3: The equation relationship between peak current and scan of NLNMO and NLNBMMO-5%

Sample	Charge process	Discharge process
NLNMO	Y=0.00615x-2.707E-5	Y=-0.00566x+2.845E-5
NLNBMMO-5%	Y=0.00673x-3.153E-5	Y=-0.00542x+2.504 E-5

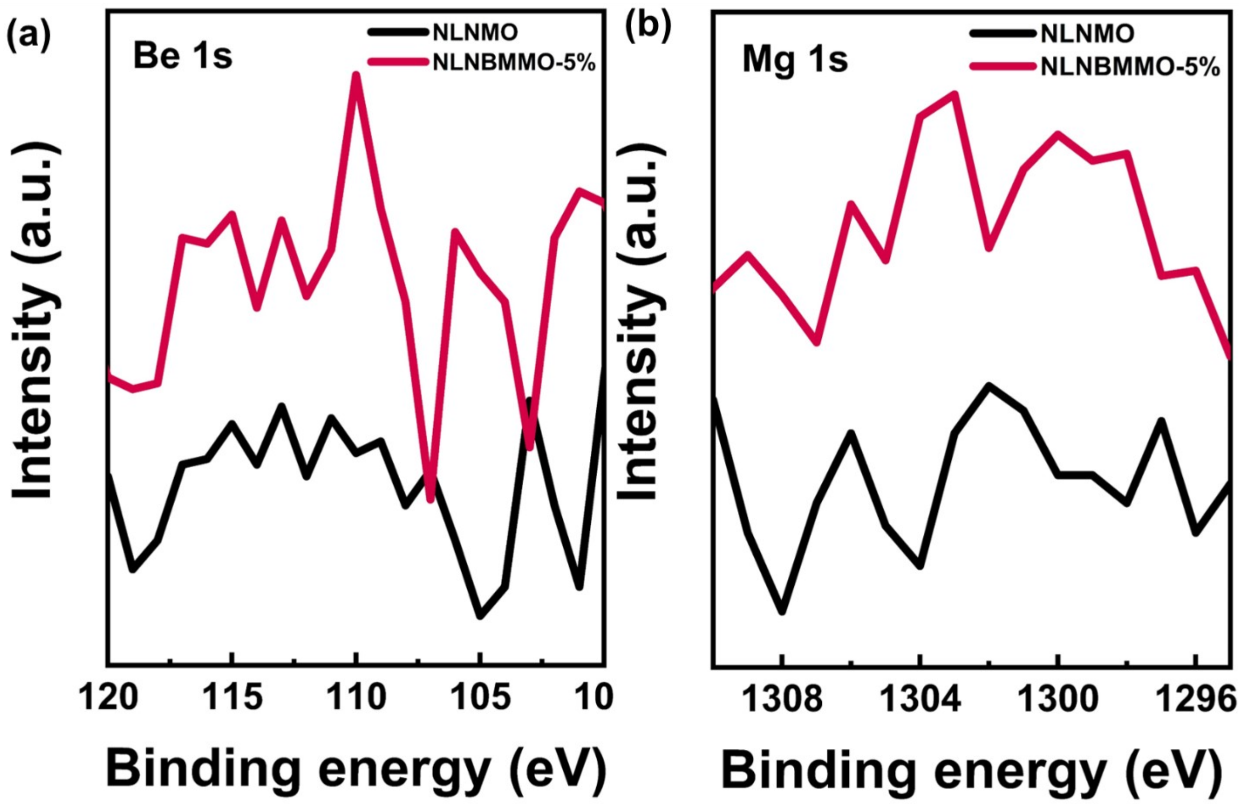

Fig. S1: (a) The Be 1s XPS spectra for NLNMO and NLNBMMO-5% (b) The Mg 1s XPS spectra for NLNMO and NLNBMMO-5%

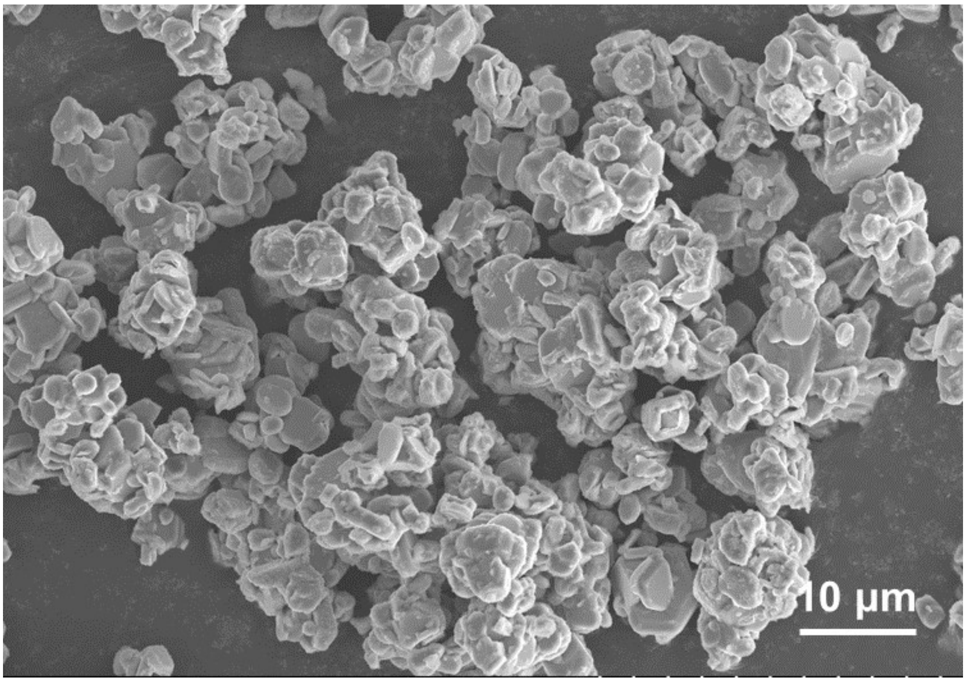

Fig. S2: The SEM image of NLNMO

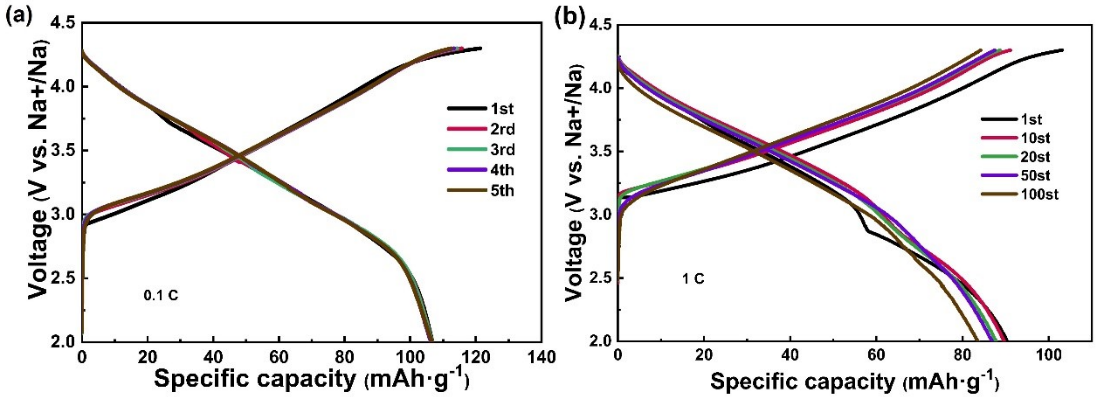

Fig. S3: (a) Galvanostatic charge-discharge profiles at 0.1 C of NLNBMMO-10% during the first 5 cycles. (b) Galvanostatic charge-discharge profiles at 1 C of NLNBMMO-10% for the 1st, 10st, 20st, 30st, and 50st cycle.

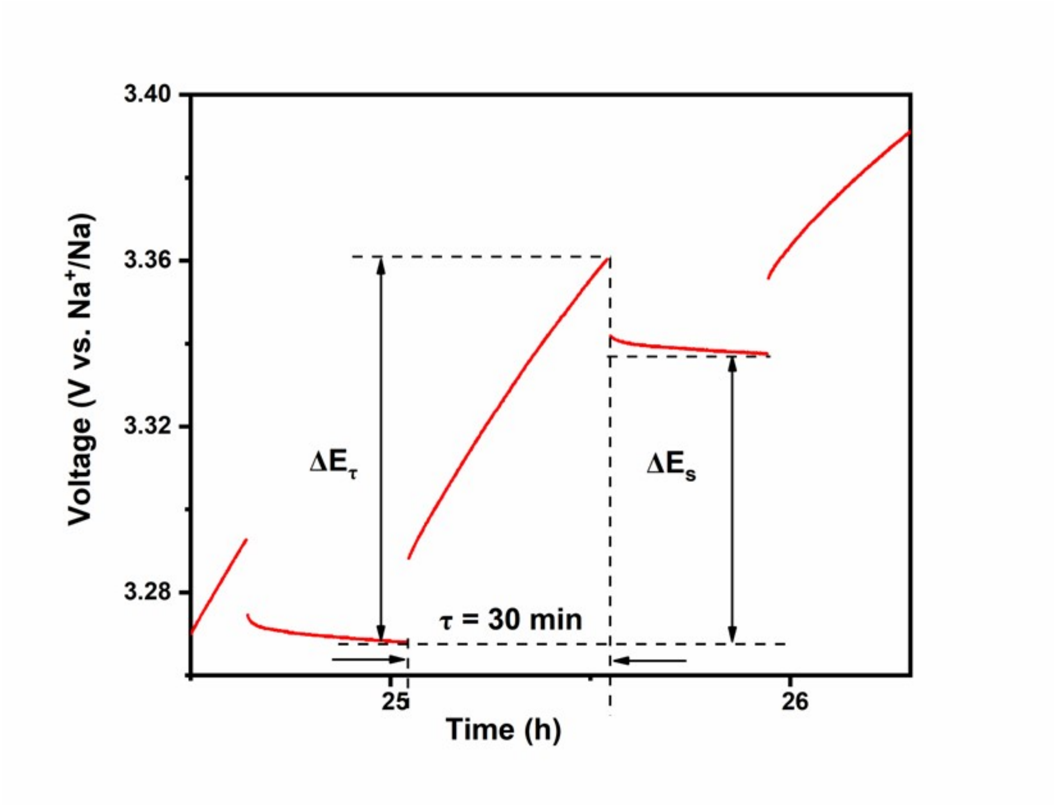

Fig. S4: Schematic illustration of selected steps of GITT test for NNMO-ZM with a charge/discharge time of 30 min.

Based on the GITT measurement, the Na^+ diffusion coefficient can be calculated by Equation S1:

$$D_{Na+} = \frac{4}{\pi\tau}\left(\frac{m_B V_M}{M_B S}\right)^2\left[\frac{\Delta E_s}{\Delta E_t}\right]^2 \quad \text{S1}$$

where D_{Na+} ($cm^2\ s^{-1}$) represents the Na^+ diffusion coefficient, V_M ($cm^3\ mol^{-1}$), m_B, and M_B are the molar volume, weight, and molar weight of the active materials, respectively, S and τ(s) denote the surface area of the electrode and the testing time in each step, and ΔE_s and ΔE_t are the quasi-equilibrium potential and the change in cell voltage E during the current pulse, respectively.[1-4]

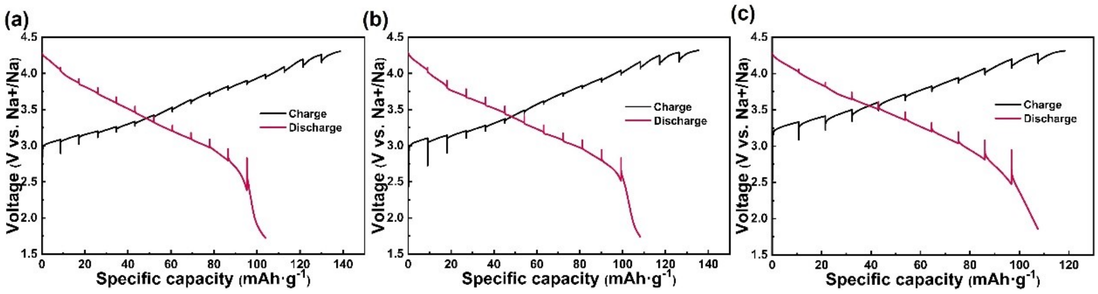

Fig. S5: (a-c) GITT curves of NLNMO, NLNBMMO-5% and NLNBMMO-10%.

Reference

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3. M. Wang, Q. Wang, X. Ding, Y. Wang, Y. Xin, P. Singh, F. Wu and H. Gao, *Interdisciplinary Materials*, 2022, **1**, 373-395.
4. Q. Wang, C. Ling, J. Li, H. Gao, Z. Wang and H. Jin, *Chemical Engineering Journal*, 2021, **425**, 130680.