

Supplementary Information

Direct observation of the in-plane crack formation of O3- Na_{0.8}Mg_{0.2}Fe_{0.4}Mn_{0.4}O₂ due to oxygen gas evolution for Na-ion batteries

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Table S1. Lattice parameters of $\text{Na}_{0.8}\text{Mg}_{0.2}\text{Fe}_{0.4}\text{Mn}_{0.4}\text{O}_2$ under various conditions.

	a axis (Å)	c axis (Å)	Volume (Å ³)
As-prepared $\text{Na}_{0.8}\text{Mg}_{0.2}\text{Fe}_{0.4}\text{Mn}_{0.4}\text{O}_2$ (Fig. S1)	2.960628(60)	16.45053(69)	124.8758(73)
$\text{Na}_{0.8}\text{Mg}_{0.2}\text{Fe}_{0.4}\text{Mn}_{0.4}\text{O}_2$ after storage in air (Fig. S6a)	2.95090(13)	16.3982(20)	123.662(19)
PDMS-coated $\text{Na}_{0.8}\text{Mg}_{0.2}\text{Fe}_{0.4}\text{Mn}_{0.4}\text{O}_2$ after storage in air (Fig. S6b)	2.95081(11)	16.4258(13)	123.862(14)
$\text{Na}_{0.8}\text{Mg}_{0.2}\text{Fe}_{0.4}\text{Mn}_{0.4}\text{O}_2$ after storage in dry CO_2 (Fig. 7a)	2.94921(11)	16.4320(15)	123.775(15)
$\text{Na}_{0.8}\text{Mg}_{0.2}\text{Fe}_{0.4}\text{Mn}_{0.4}\text{O}_2$ after storage in wet Ar (Fig. 7a)	2.94800(12)	16.4268(15)	123.634(15)

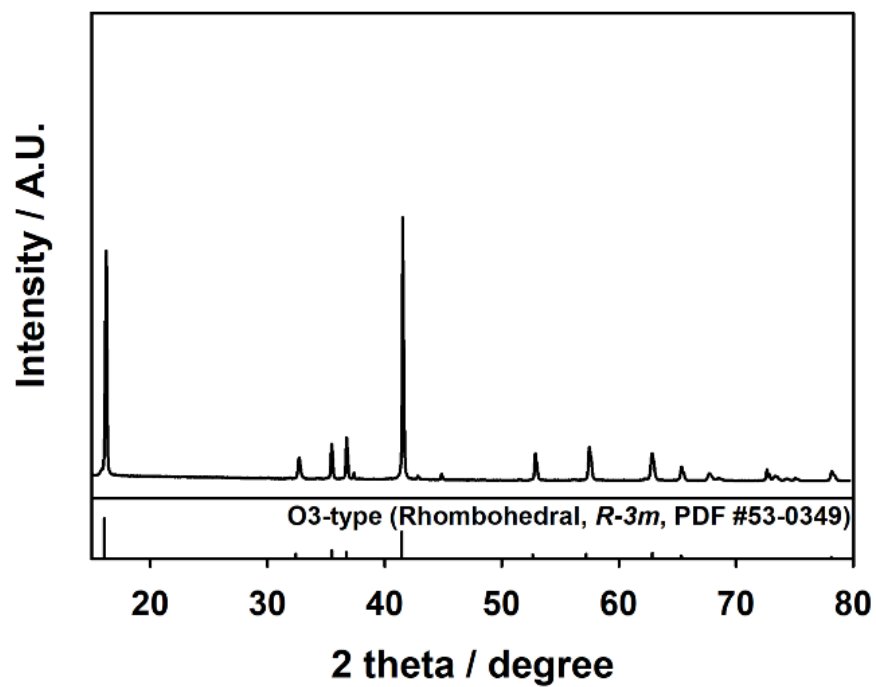


Fig. S1 XRD pattern of $\text{Na}_{0.8}\text{Mg}_{0.2}\text{Fe}_{0.4}\text{Mn}_{0.4}\text{O}_2$ powders.

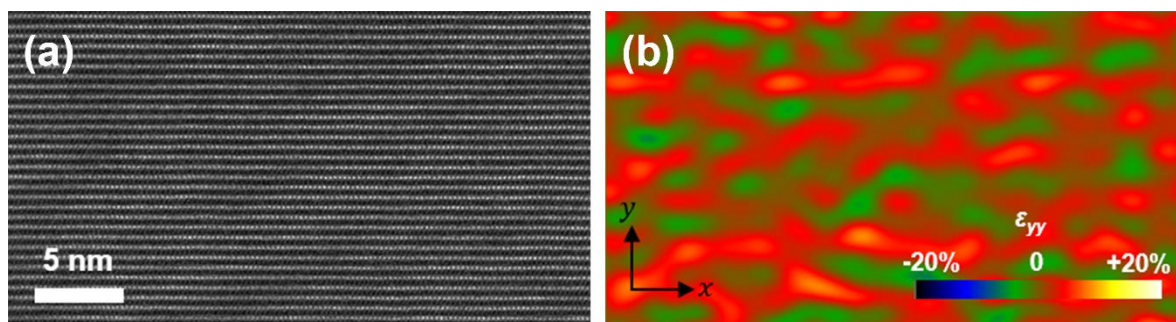


Fig. S2 (a) HAADF-STEM image of bare $\text{Na}_{0.8}\text{Mg}_{0.2}\text{Fe}_{0.4}\text{Mn}_{0.4}\text{O}_2$ particles before storage and (b) the corresponding two-dimensional strain map using GPA.

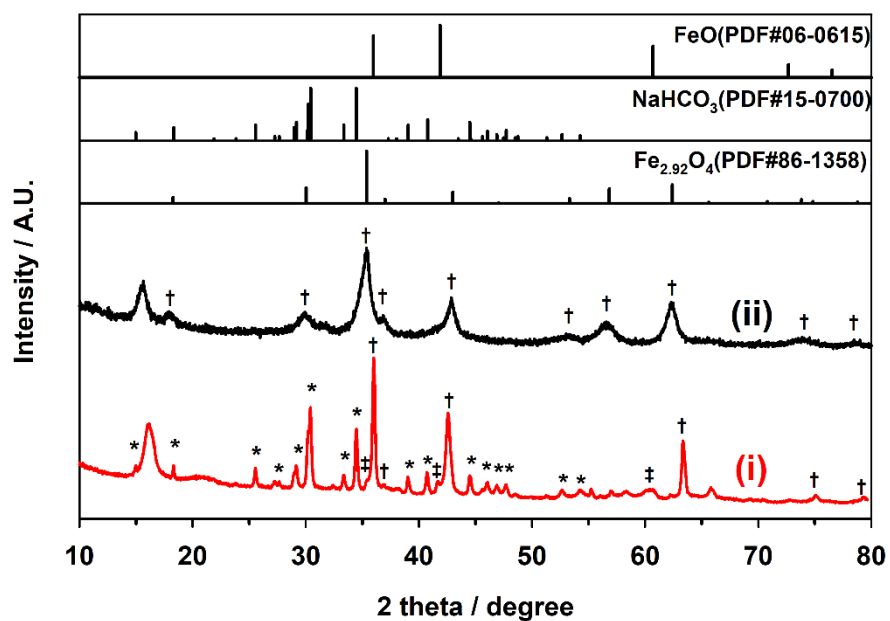


Fig. S3 XRD patterns of $\text{Na}_{0.8}\text{Mg}_{0.2}\text{Fe}_{0.4}\text{Mn}_{0.4}\text{O}_2$ powders after storage in wet CO_2 (i) without and (ii) with heating at $500\text{ }^\circ\text{C}$ in N_2 atmosphere. $\text{Na}_{0.8}\text{Mg}_{0.2}\text{Fe}_{0.4}\text{Mn}_{0.4}\text{O}_2$ powders were washed with deionized water to remove residual sodium compounds before heat treatment. (FeO: double dagger, $\text{Fe}_{2.92}\text{O}_4$: dagger, and NaHCO_3 : asterisk)

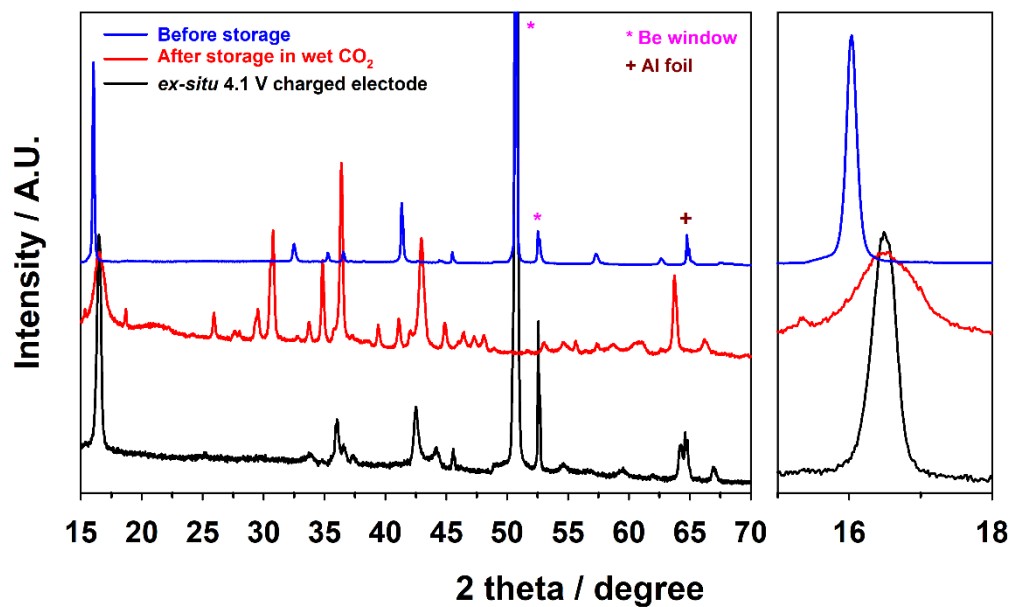


Fig. S4 XRD patterns of $\text{Na}_{0.8}\text{Mg}_{0.2}\text{Fe}_{0.4}\text{Mn}_{0.4}\text{O}_2$ electrode after charging at 4.1 V (vs. Na/Na^+) and $\text{Na}_{0.8}\text{Mg}_{0.2}\text{Fe}_{0.4}\text{Mn}_{0.4}\text{O}_2$ powders before and after storage in wet CO_2 .

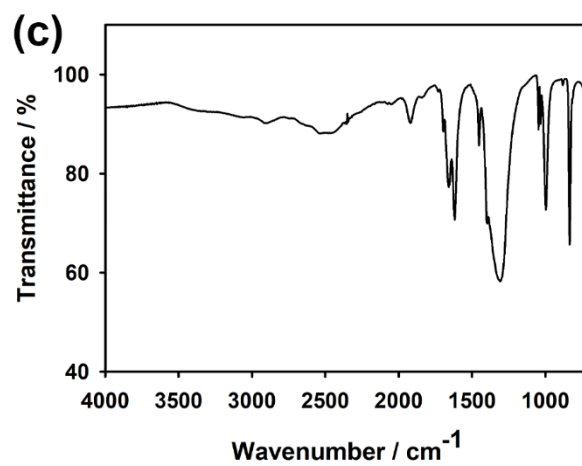
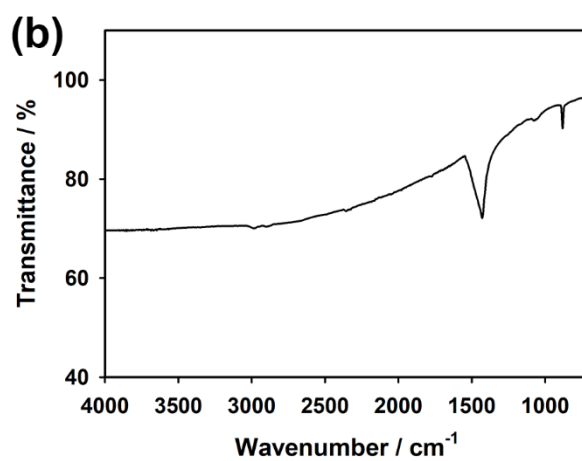
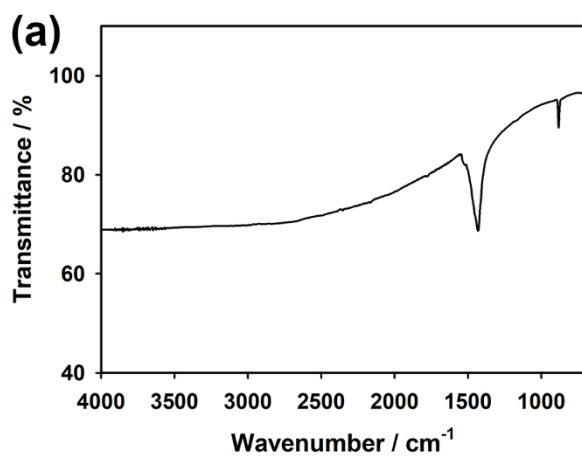


Fig. S5 FT-IR spectra of $\text{Na}_{0.8}\text{Mg}_{0.2}\text{Fe}_{0.4}\text{Mn}_{0.4}\text{O}_2$ after storage (a) in dry CO_2 , (b) in wet Ar and (c) in wet CO_2 for 1 day.

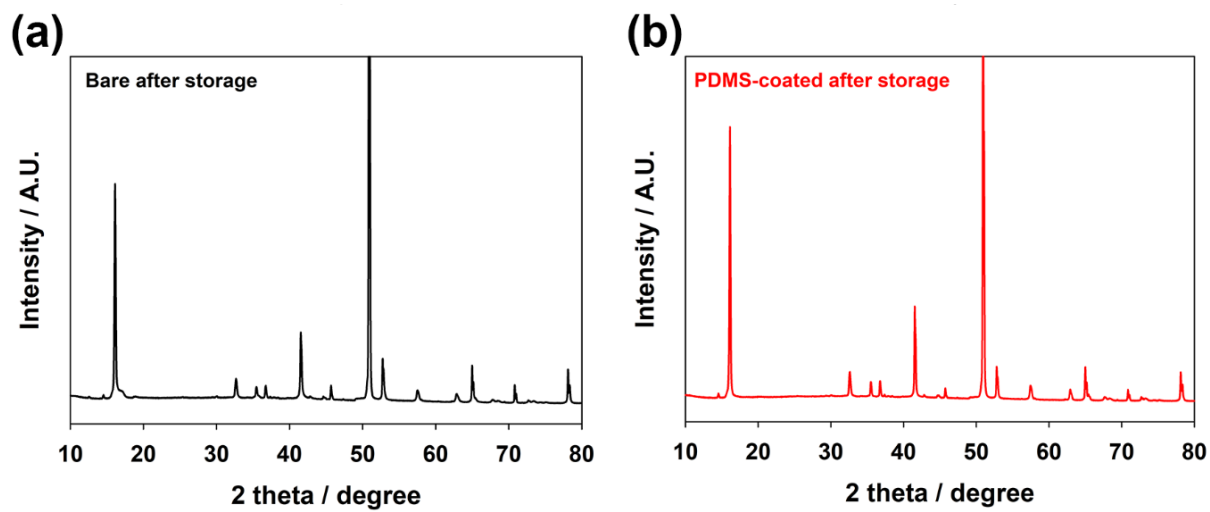


Fig. S6 XRD patterns of (a) bare and (b) PDMS-coated $\text{Na}_{0.8}\text{Mg}_{0.2}\text{Fe}_{0.4}\text{Mn}_{0.4}\text{O}_2$ electrodes after storage in air at a RH of 50% and 25 °C for 2 weeks.

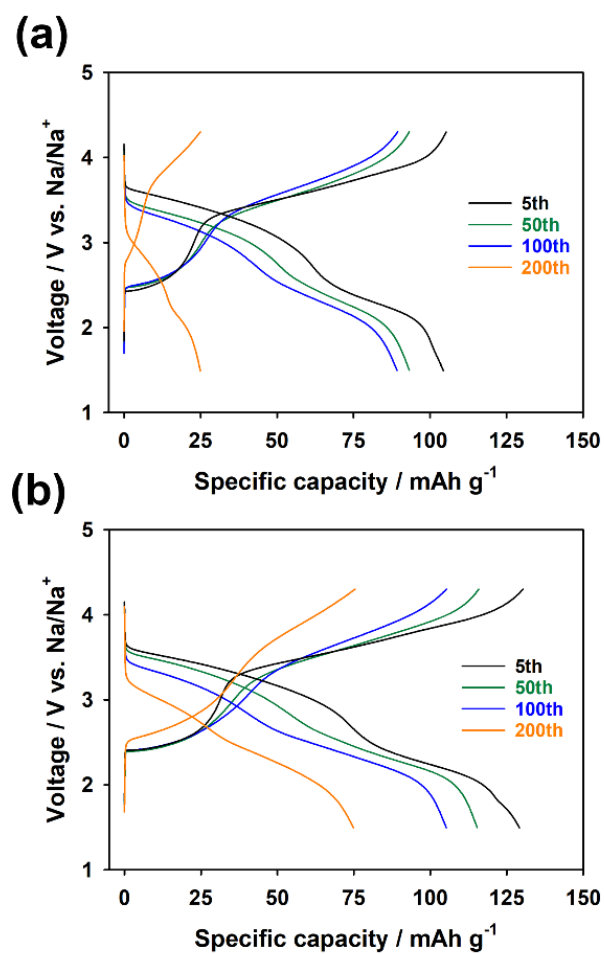


Fig. S7 Voltage profiles of (a) bare and (b) PDMS-coated $\text{Na}_{0.8}\text{Mg}_{0.2}\text{Fe}_{0.4}\text{Mn}_{0.4}\text{O}_2$ electrodes after storage in air at a RH of 50% and 25 °C for 2 weeks at 0.5 C-rate (90 mA g^{-1}) for various cycle numbers.

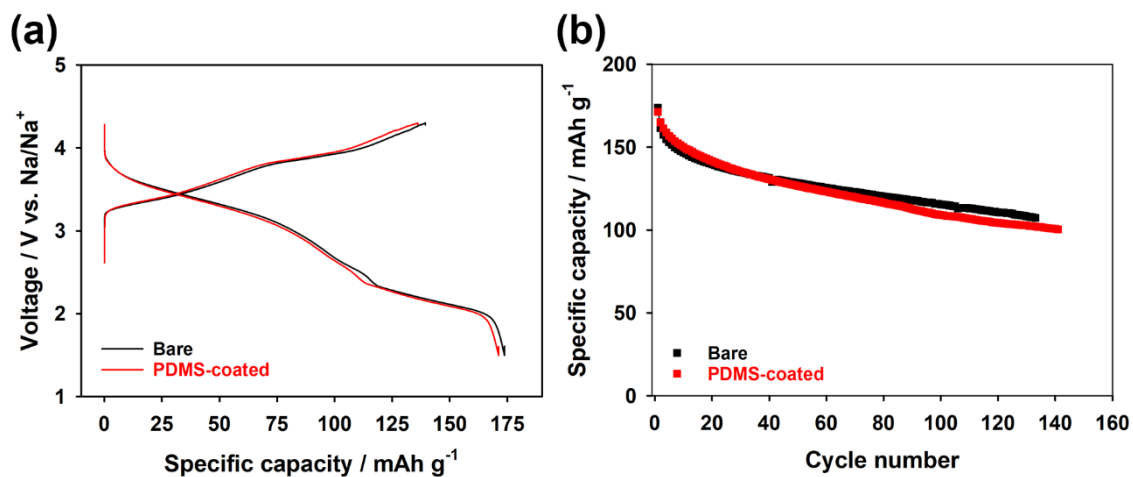


Fig. S8 (a) Voltage profiles of bare and PDMS-coated $\text{Na}_{0.8}\text{Mg}_{0.2}\text{Fe}_{0.4}\text{Mn}_{0.4}\text{O}_2$ without air exposure for the first cycle at a 0.1 C-rate (18 mA g⁻¹). (b) Cycle performances of bare and PDMS-coated $\text{Na}_{0.8}\text{Mg}_{0.2}\text{Fe}_{0.4}\text{Mn}_{0.4}\text{O}_2$ without air exposure at a 0.1 C-rate (18 mA g⁻¹).