Supporting Information

Structural evolution from layered $Na_2Ti_3O_7$ to $Na_2Ti_6O_{13}$ nanowires enabling a highly reversible anode for Mg-ion batteries

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Experimental Section

Materials Characterization

X-ray diffraction (XRD) patterns were acquired on a Rigaku Ultima IV diffractometer using Ni filtered Cu Ka radiation (λ=1.5406Å). The morphology and structure of the samples were studied using scanning electron microscopy (SEM, S8010 instrument) and transmission electron microscopy (TEM, TECNAI G2 F20). Raman spectra were obtained using a LabRAM HR Evolution (HORIBA Jobin Yvon) instrument with a 532 nm laser in ambient air. The TG was taken on a TA-60WS in air from room temperature to 800 °C at a heating rate of 10 °C min^{-1} .

Electrochemical Measurements

The CR 2025 coin cells were assembled in an argon-filled glovebox. The working electrode were fabricated to form a freestanding film with 70 wt% active material, 20 wt% conductive carbon (Super P),

and 10wt% polytetrafluoroethylene (PTFE) binder by milling in agate mortar and then dried at 120 °C in the vacuum drying oven about 12 h. Then it was cut and pressed on Ti mesh and the loading for each electrode is approximately 1.5-2 mg cm^{-2}. Polished Mg foil was used as the counter electrode and glass fiber separator (WhatmanGF/F) was used as the separator. The 0.4M $(PhMgCl)_2$-$AlCl_3$/tetrahydrofuran (APC/THF) electrolyte was used as the electrolyte. Galvanostatic charge–discharge measurement was tested on a multichannel battery testing system (Land CT 2001A, China) in the potential range 0.01-2 V versus Mg^{2+}/Mg at room temperature. Cyclic voltammetry (CV) were measured on Zennium (Zahner) at a scan rate of 0.5 mV s^{-1}.

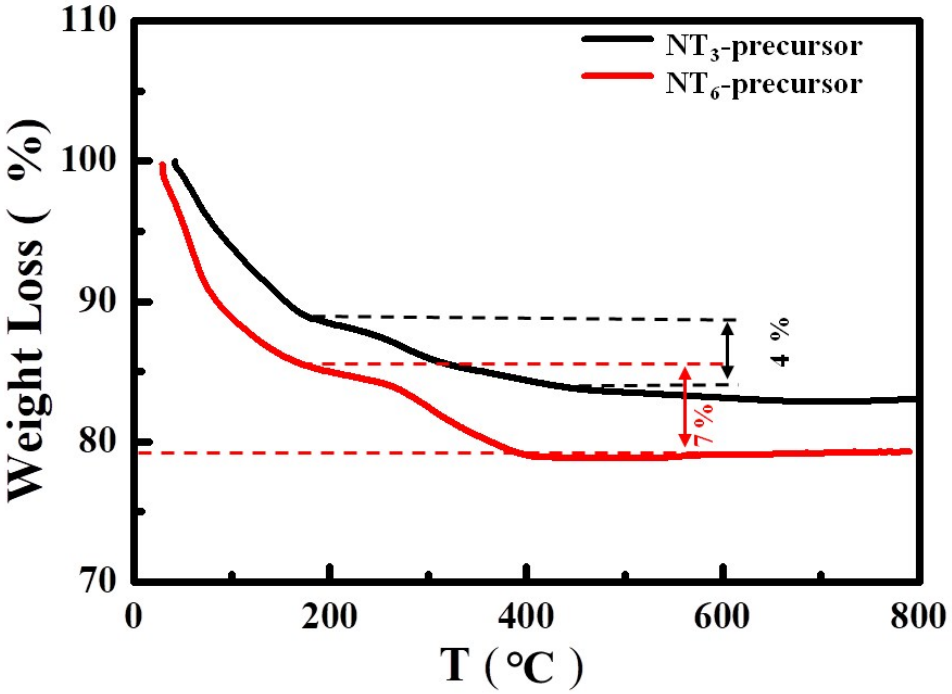

Fig.S1 TGA curve of different titanate precursors heated under air condition.

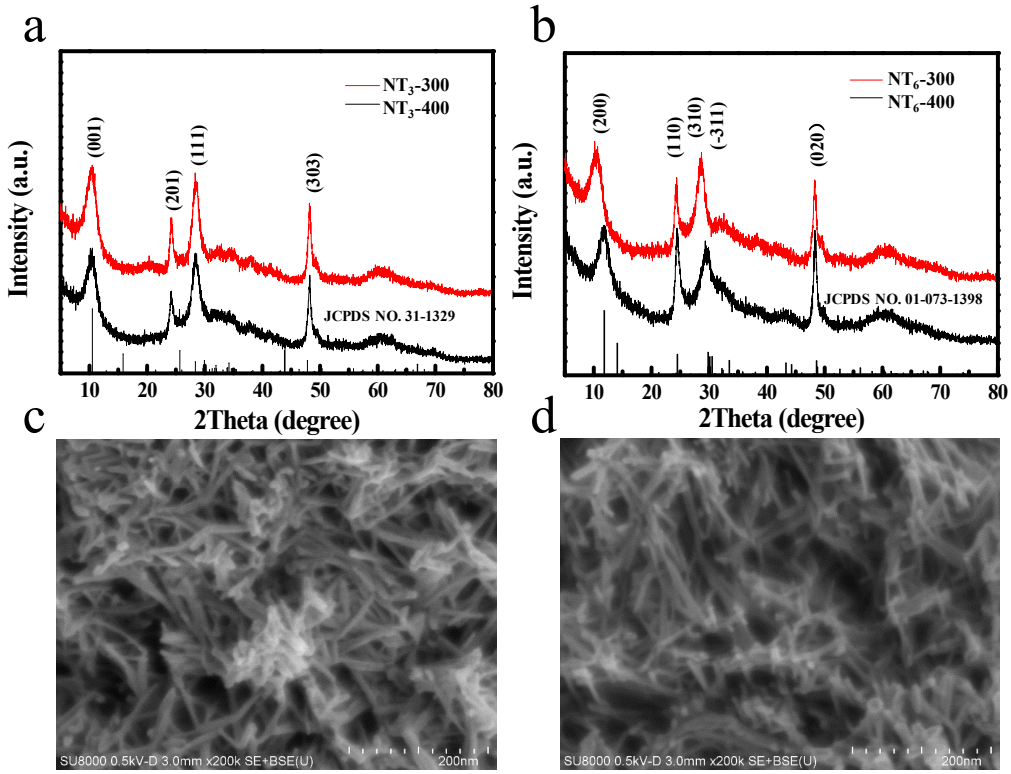

Fig.S2 XRD patterns of (a) NT_3-300 and NT_3-400, (b) NT_6-300 and NT_6-400. SEM images of (C) NT3-400 and (d) NT6-400.

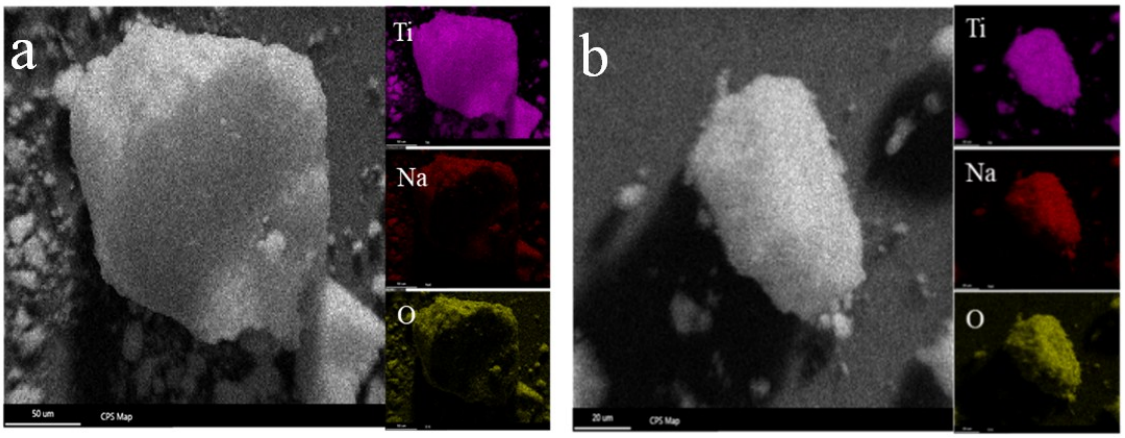

Fig.S3 Corresponding EDX element mapping images of (a) NT_3 and (b) NT_6.

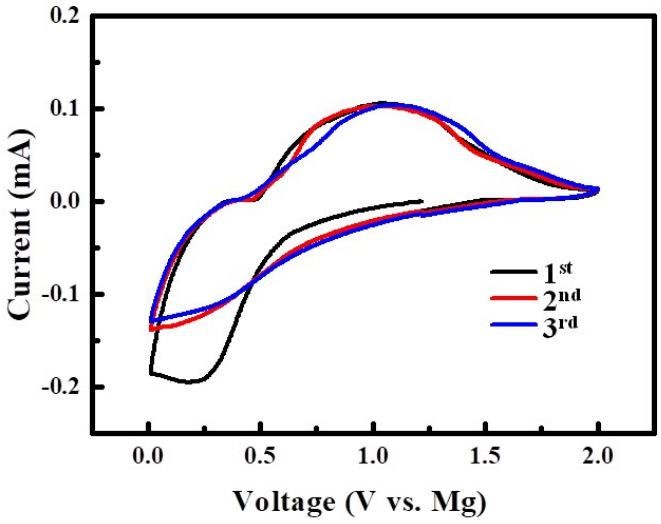

Fig.S4 Cyclic voltammograms for NT_3-300 at a scan rate of 0.5 mV s^{-1} between 0.01-2 V .

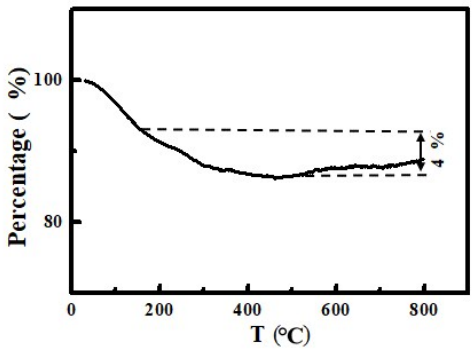

Fig. S5 TG curves of NT_6 obtained under 300℃.

Table S 1 Comparison of Mg storage performance of related anodes.

Materials reference	**Electrolyte**	**Potential range (vs. Mg 2+ /Mg)**	**ICE**	**Reversible capacity**
$NaMgTi_3O_7$ [19]	0.25 M $(PhMgCl)_2$ - $AlCl_3$ /THF (APC)	0.01-2.00 V	67.4%	91 mA h/g at
$Li_4Ti_5O_{12}$[21]	0.25M $Mg(AlCl_2BuEt_2)_2$/THF	0.01-2.00 V	71.4%	25 mAh/g at 15 mA/g
TiO_2 -B[20]	0.4 M APC in THF	0.01-2.00 V	55.6%	79 mAh/g at 10 mA/g
cation-deficient anatase TiO_2[22]	0.2 M APC in THF	0.05–2.3 V	84.8%	140mAh/g at 20 mA/g
B-TiO_{2-x}[23]	0.4 M APC in THF	0.05−2.1 V	70.5%	134mAh/g at 50 mA/g (from the rate performance)
$Na_2Ti_6O_{13}$ This work	0.4 M APC in THF	0.01-2.00 V	89.1%	165.8 mAh/g at 10mA/g

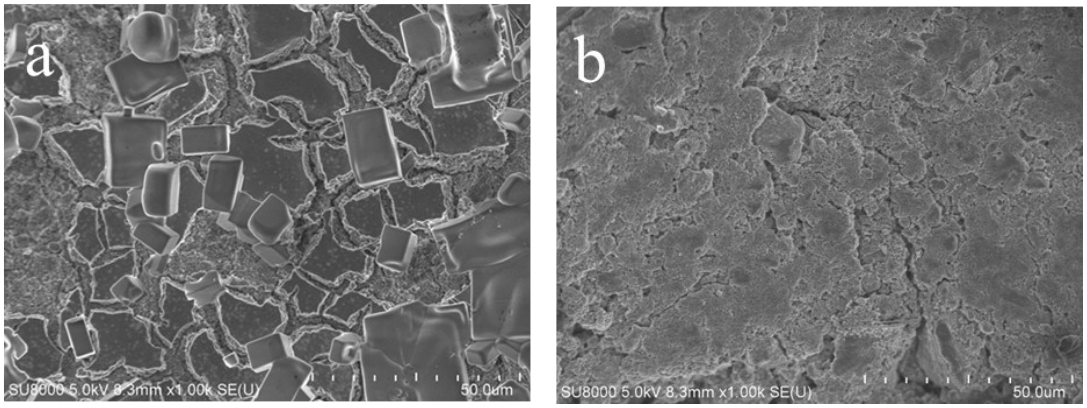

Fig.S6 SEM images of (a)NT_3 and (b) NT_6 electrodes after the first cycle.

Table S2 The contents of the elements for different electrodes after first cycle.

Actom%	Na	Ti	Cl	O	Mg
NT_3	22.29	18.23	8.1	46.17	5.21
NT_6	14.43	17.15	6.32	53.44	8.67