Supporting information

$Bi_2Mn_4O_{10}$: A New Mullite-type Anode Material for Lithium Ion Batteries

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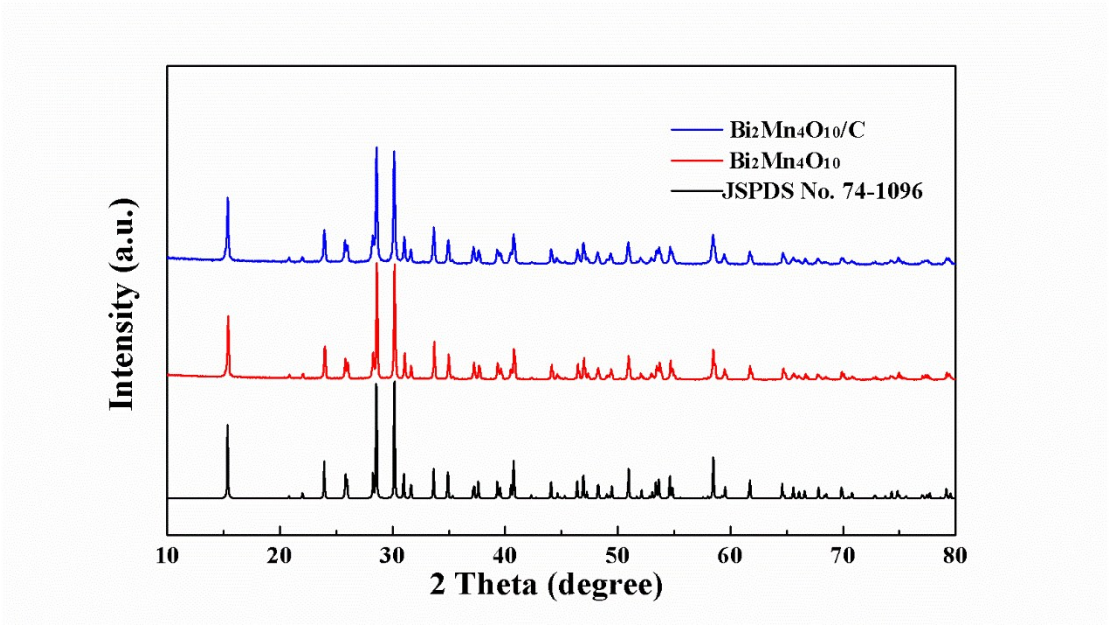

Fig. S1 X-ray diffraction patterns of $Bi_2Mn_4O_{10}$ and $Bi_2Mn_4O_{10}$/C

Table S1 Rietveld refinement parameters and results obtained for $Bi_2Mn_4O_{10}$

Atom	**Wyck.**	***x/a***	***y/b***	***z/c***	**U^0(Å^2)**
Bi1	4g	0.15932(7)	0.16557(8)	0	0.0136(2)
Mn1	4f	0.5	0	0.2608(4)	0.0128(6)
Mn2	4h	0.40670(23)	0.35065(28)	0.5	0.0078(6)
O1	4e	0	0	0.3017(11)	0.0140(26)
O2	8i	0.3876(7)	0.1998(6)	0.2677(7)	0.0220(17)
O3	4h	0.1431(10)	0.4225(7)	0.5	0.0096(21)
O4	4g	0.1592(11)	0.4466(8)	0	0.0216(26)

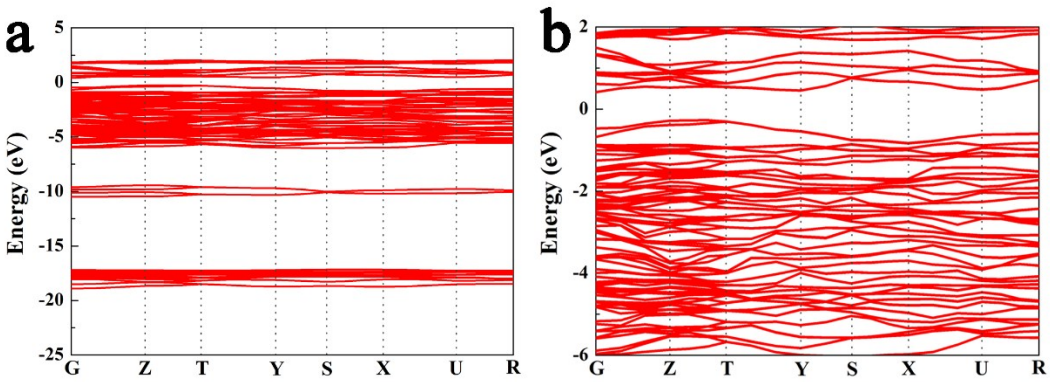

Fig. S2 (a) and (b) Band structure of $Bi_2Mn_4O_{10}$. The band gap is 0.7082 eV.

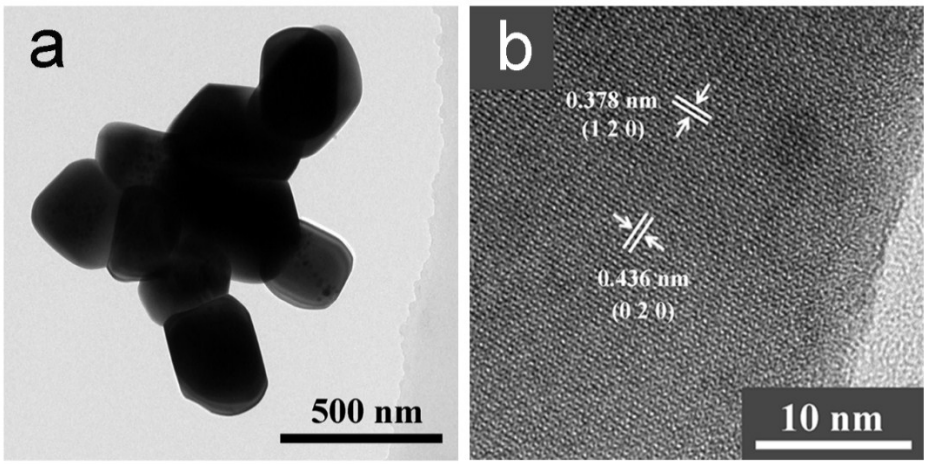

Fig. S3 TEM and HRTEM images of bare BMO.

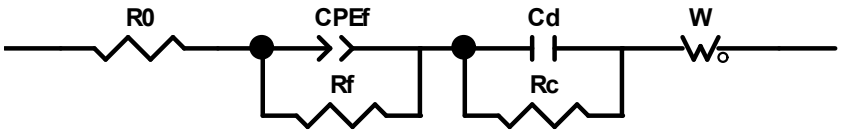

Fig. S4 A proposed equivalent circuit for describing the EIS behavior. The circuit elements are R_0 (electrolyte resistance), CPE_f (constant phase element represents the surface film capacitance) and R_f (surface film resistance), C_d and R_c (double layer capacitance and charge transfer resistance, respectively, in the electrode – electrolyte interface), and W (the Warburg element, which is characterizes diffusion of lithium ions).

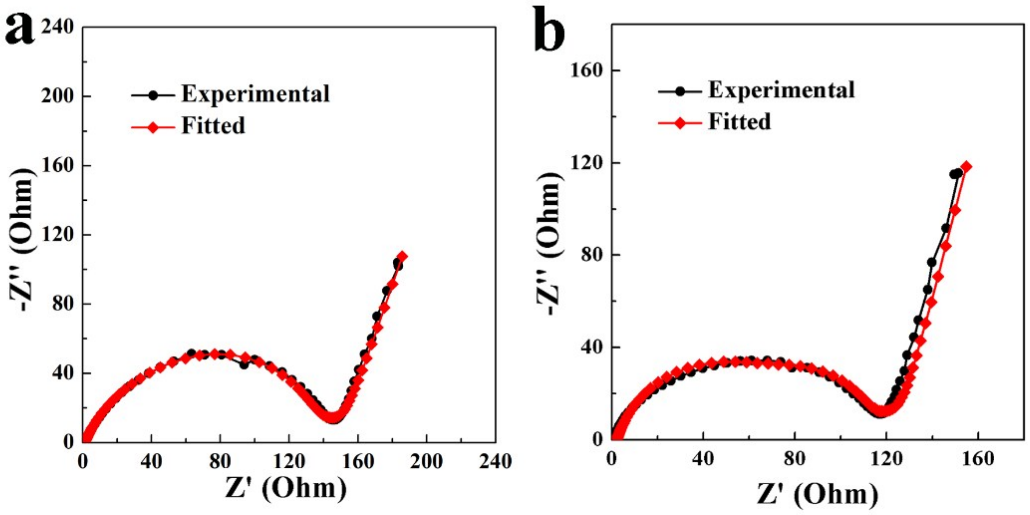

Fig. S5 Experimental and fitted Nyquist plots of bare $Bi_2Mn_4O_{10}$ (a) and $Bi_2Mn_4O_{10}$/C composite (b) anodes

Table S2 The fitted impedance parameters of $Bi_2Mn_4O_{10}$ and $Bi_2Mn_4O_{10}$/C anodes

$Bi_2Mn_4O_{10}$			$Bi_2Mn_4O_{10}$/C		
Element	Value	Error%	Element	value	Error%
R_0	1.286	~3.245%	R_0	1.084	~2.568%
CPE_f-T	4.1024×10^{-5}	~5.938%	CPE_f-T	1.4048×10^{-5}	~6.512%
CPE_f-P	0.7492	~0.788%	CPE_f-P	0.8286	~0.577%
R_f	83.46	~2.408%	R_f	72.79	~2.891%
C_d	2.6735×10^{-5}	~6.749%	C_d	6.11×10^{-5}	~6.497%
R_c	48.02	~4.523%	R_c	32.84	~3.807%
W-R	51.54	~4.889%	W-R	51.29	~4.081%
W-T	0.6182	~6.754%	W-T	0.5973	~5.445%
W-P	0.3957	~0.716%	W-P	0.4204	~0.795%

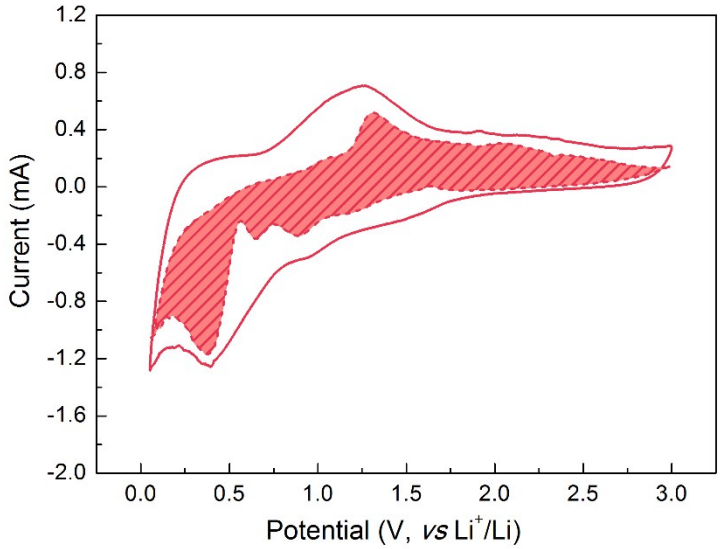

Fig. S6 Current response with voltage at the scan rate of 0.5 mV s^{-1}. The solid line is the current signal obtained from the cyclic voltammetry experiment. The Shaded region with dash line is calculated capacitive current using $i(V) = k_1 v$.

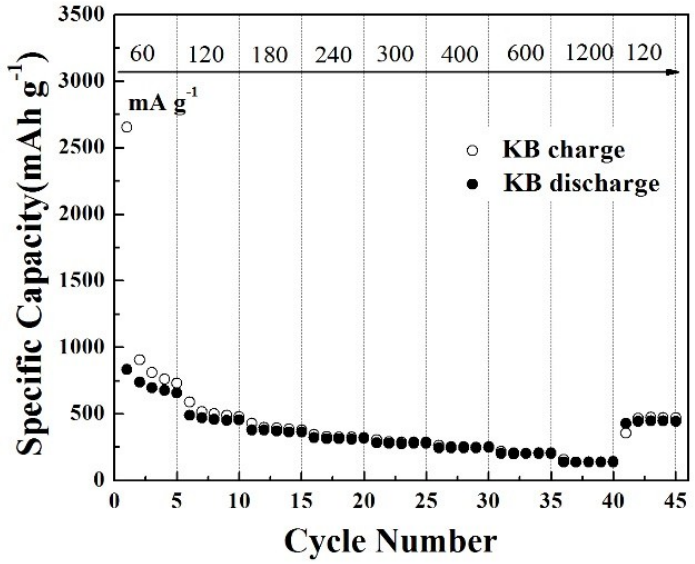

Fig. S7 The rate performance of conductive carbon (KB).

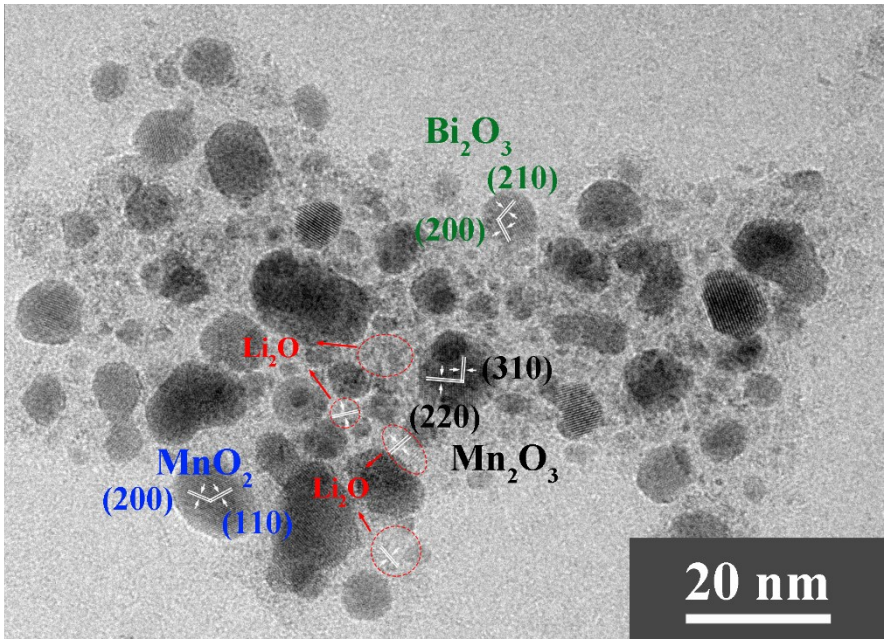

Fig. S8 Ex-situ TEM image of the charged electrode at 3.0 V after 100 discharge-charge cycles. The metal oxide nanoparticles are surrounded by Li_2O buffering matrix.

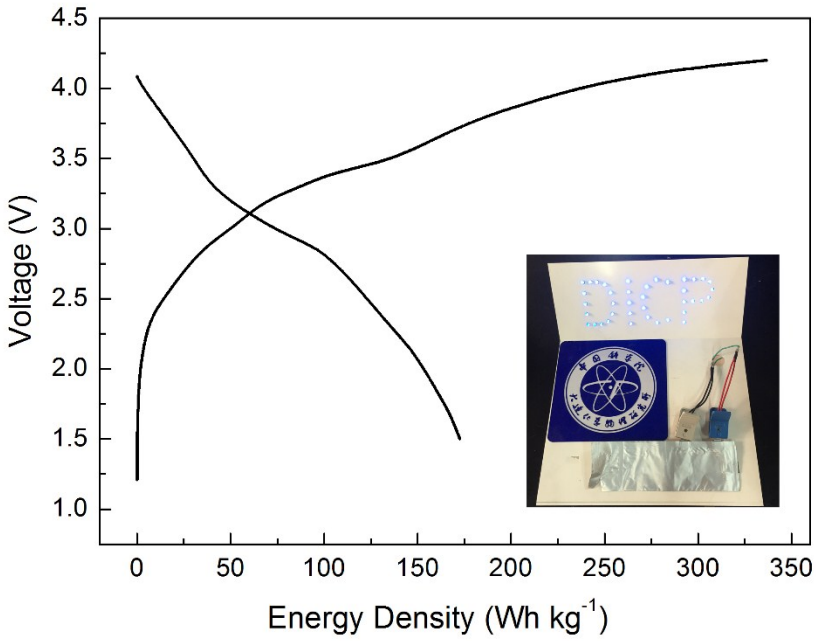

Fig. S9 The charge/discharge performance of $LiMn_2O_4|Bi_2Mn_4O_{10}$/C full battery at 0.2 C rate. The mass loading of the $LiMn_2O_4$ in cathode and $B_{i2}Mn_4O_{10}$/C in anode are ~4.0 mg cm^{-2} and ~0.4 mg cm^{-2}, respectively.

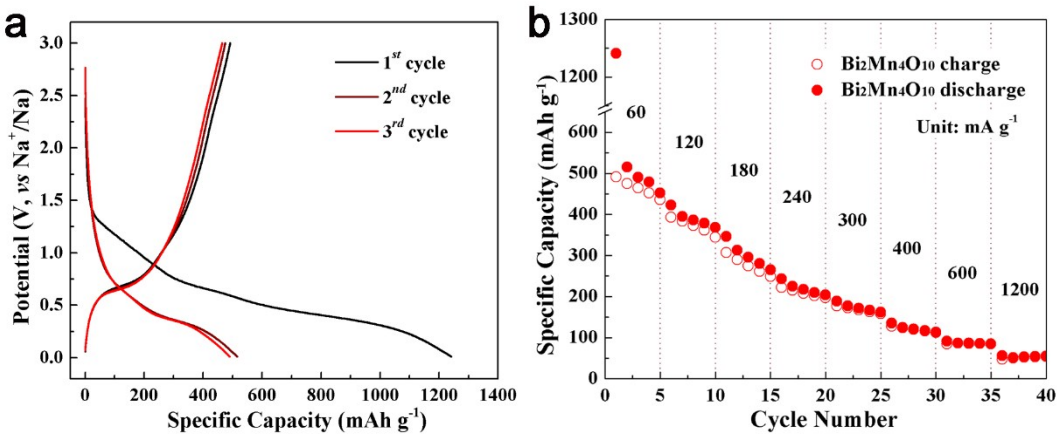

Fig. S10 Discharge-charge curves at 60 mA g^{-1} (a) and the rate performance (b) of BMO/C anode for sodium-ion battery (SIB).