Electronic Supplementary Material (ESI) for Journal of Materials Chemistry A

Facile Synthesis of Manganese Oxide/Aligned Carbon Nanotubes over Aluminium Foil as 3D Binder Free Cathodes for Lithium Ion Batteries

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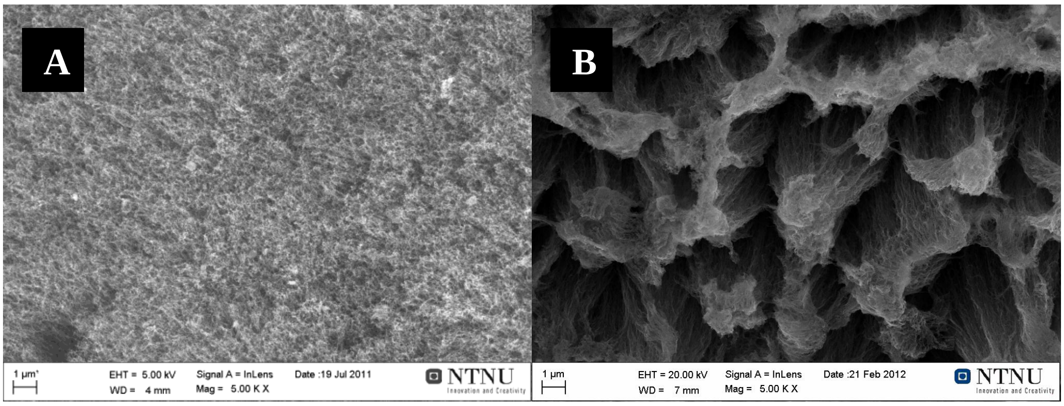

Figure S1 Top view of ACNT (A) and MCA-3-200 (B).

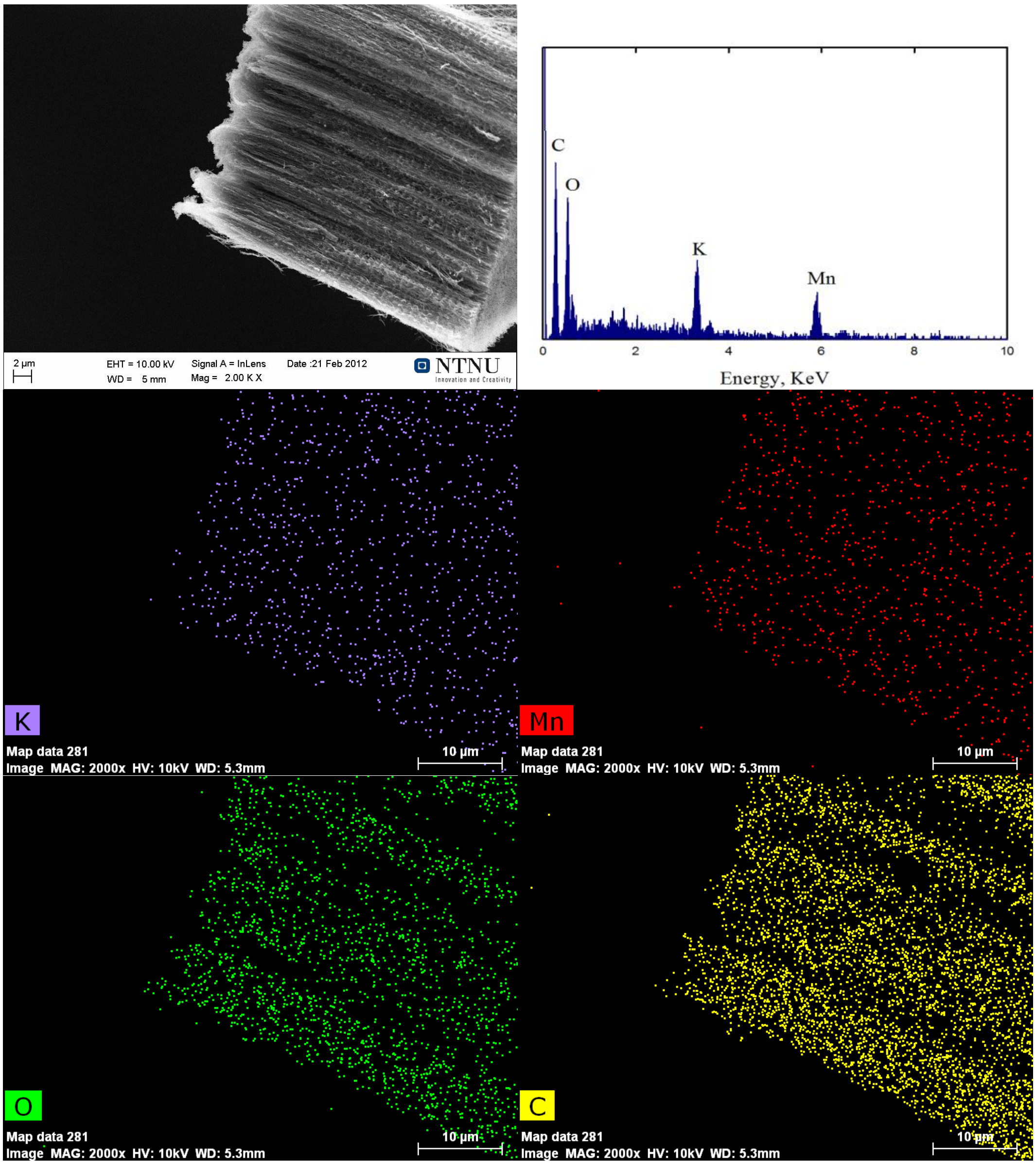

Figure S2 EDS and elemental mapping of MCA-3.

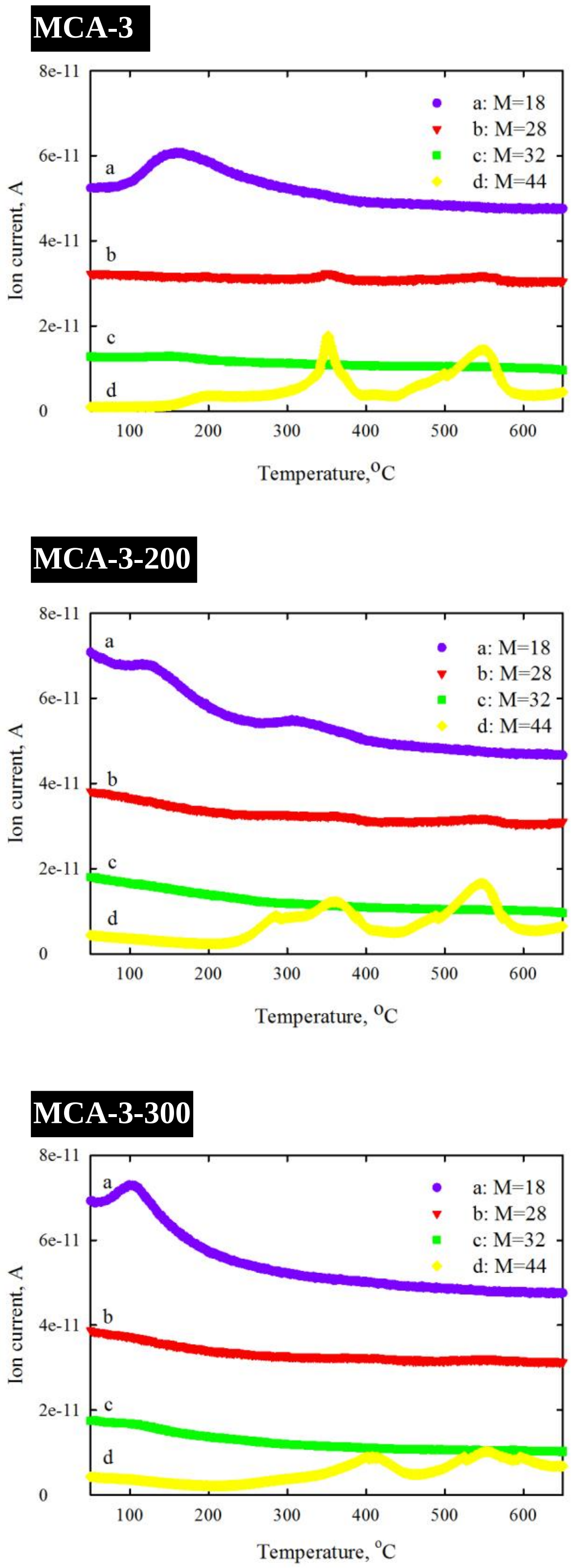

Figure S3 Mass spectra when the samples were analyzed by TG.

Table S1 Textual properties of the as synthesized namomaterials.

Sample	Surface area, m^2 g^{-1}	Pore Volume, cm^3 g^{-1}	Average pore size, Å
ACNT	130.2	0.324	95.1
MCA-3	85.2	0.179	122.3
MCA-3-200	52.9	0.155	144.1
MCA-3-300	44.3	0.112	200.5

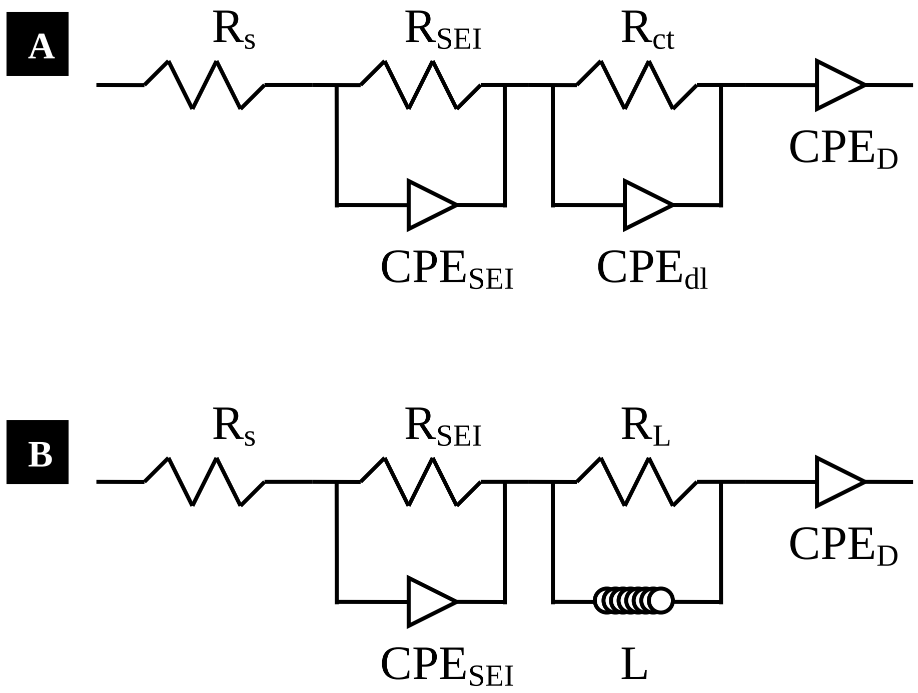

Figure S4 Equivalent circuit I (A). It consists of ohmic (R_s), SEI film (R_{SEI}) and charge transfer (R_{ct}) resistances, the SEI (CPE_{SEI}) and double layer (CPE_{dl}) capacitance, along with a diffusion component (CPE_D). Equivalent circuit II (B). It consists of ohmic (R_s) and SEI film (R_{SEI}) resistances, the SEI (CPE_{SEI}) capacitance, the parallel inductance (L) and resistance (R_L) along with a diffusion component (CPE_D).

Table S2 The equivalent circuit parameters obtained from simulation of EIS experimental data of MCA-3 at various DOD by using equivalent circuit I.

DOD		10%	20%	40%	60%
R_s, Ω		2.7	2.5	2.6	3.1
CPE_{SEI}[a]	Y_0, F	2.8E-7	3.6E-7	4.9E-7	3.4E-7
	n	0.99	0.98	0.95	1
R_{SEI}, Ω		3.8	4.0	4.3	3.6
CPE_{dl}[a]	Y_0, F	0.00027	0.00033	0.00029	0.00022
	n	0.73	0.70	0.71	0.66
R_{ct}, Ω		4.0	4.2	7.1	19.6
CPE_D[a]	Y_0, F	0.14	0.13	0.086	0.042
	n	0.81	0.81	0.79	0.75

[a] Y_0 and n were evaluated from the equation $Z_{CPE}=Y_0^{-1}*(j\omega)^{-n}$.

Table S3 The equivalent circuit parameters obtained from simulation of EIS experimental data of MCA-3-200 at various DOD by using equivalent circuit I when DOD is 10% and 20%, and using and equivalent circuit II when DOD is 40% and 60%.

DOD		10%	20%	40%	60%
R_s, Ω		2.7	3.0	3.0	3.0
CPE_{SEI}[a]	Y_0, F	3.2E-7	2.3E-7	8.7E-7	6.4E-7
	n	0.88	0.90	0.79	0.82
R_{SEI}, Ω		10.8	10.9	18.8	16.7
L, H or CPE_{dl}[a]	Y_0, F	6.8E-5	5.5E-5	0.00033	0.00010
	n			0.55	0.57
R_L or R_{ct}, Ω		2.7	2.5	11.4	38.7
CPE_D[a]	Y_0, F	0.079	0.075	0.034	0.022
	n	0.73	0.73	0.64	0.55

[a] Y_0 and n were evaluated from the equation $Z_{CPE}=Y_0^{-1}*(j\omega)^{-n}$.

Table S4 The equivalent circuit parameters obtained from simulation of EIS experimental data of MCA-3 after various cycles by using equivalent circuit I.

DOD		5th	20th	100th
R_s, Ω		2.6	2.7	3.7
CPE_{SEI}[a]	Y_0, F	4.9E-7	8.1E-7	6.4E-7
	n	0.95	0.88	0.89
R_{SEI}, Ω		4.3	41.9	53.2
CPE_{dl}[a]	Y_0, F	0.00029	0.00042	0.00017
	n	0.71	0.95	0.66
R_{ct}, Ω		7.1	9.5	18.6
CPE_D[a]	Y_0, F	0.086	0.057	0.042
	n	0.79	0.70	0.74

[a] Y_0 and n were evaluated from the equation $Z_{CPE}=Y_0^{-1}*(j\omega)^{-n}$.

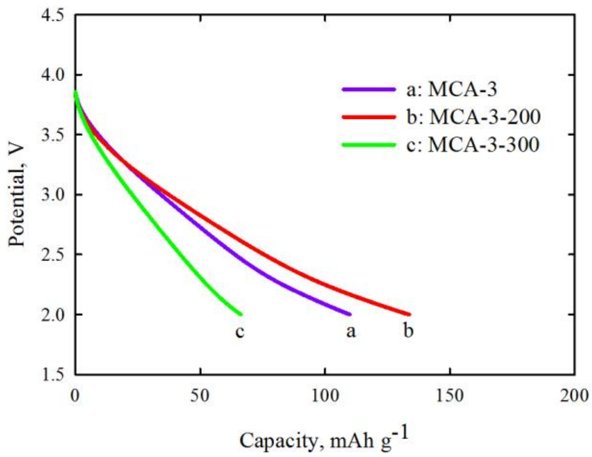

Figure S5 Discharge profiles of MCA at 1 C after 100 cycles.

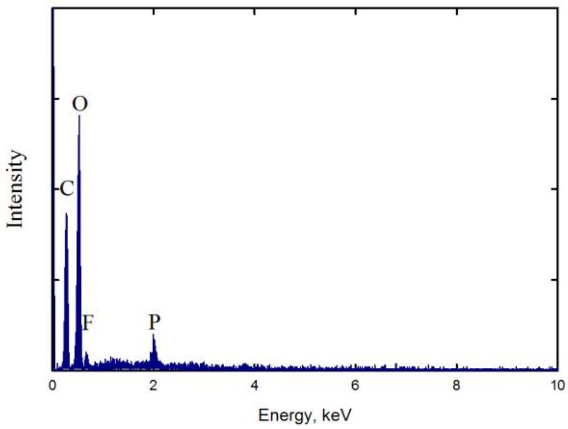

Figure S6 EDS of lithium foil after 100 cycles.