< **Supporting information** >

One-Step Transformation of MnO_2 into MnO_{2-x}@Carbon Nanostructures for High-Performance Supercapacitors using Structure-Guided Combustion Waves

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Calculation of specific capacitance from scan rate or current density

A specific capacitance was calculated from the CV curve by the subtraction of the capacitance between bare MWCNT electrode and MnO_x/MWCNT electrode using the following equation:

$$C = \frac{\int_{V_1}^{V_2} \{I_v(MnO_x/MWCNT) - I_v(MWCNT)\}dV}{\Delta V \times v \times m\,(MnO_x)}$$

where *C* is the specific capacitance (F/g), I_v is the current at a specific scan rate during charge and discharge cycling (A), ΔV is the applying voltage (V), *v* is the scan rate (V/s), and *m* is the mass of deposited MnO_x (g).

A Specific capacitance was also obtained from the charge–discharge cycle (current density) using the following equation:

$$C = \frac{I \times \Delta t}{\Delta V \times m\,(MnO_x)}$$

where *C* is the specific capacitance (F/g), *I* is the current during charge and discharge cycling (A), Δt is the discharge time (s), ΔV is the potential window (V), and *m* is the mass of deposited MnO_x (g).

Cyclic voltammetry (CV) curves for $Mn_2O_3/Mn_3O_4/MnO@C$, MnO@C and MnO_2 electrodes.

All electrodes, fabricated by filtrating manganese oxide nanoparticles and nanostructures on MWCNT current collector film were investigated through cyclic voltammetry (CV) (Figure S1). CV curves were measured in 0.8 V potential window, at scan rates of 10, 25, 50, 100, 250 and 500 mV/s within Na_2SO_4 1 M electrolyte.

Galvanostatic charge-discharge curves were measured at various current densities of 0.5, 1, 2, 5 and 10 A/g with the potential window between 0 and 0.8 V for $Mn_2O_3/Mn_3O_4/MnO@C$ (Figure S2a) and MnO@C (Figure S2b). Those charge-discharge curves showed good bilateral symmetry and linear energy quantity slopes at both charging and discharging periods. The highest specific capacitance based on the current density rate was 415.6 F/g at 0.5 A/g of current density. The larger current density resulted in the smaller specific capacitance for all electrodes (Figure S2c).

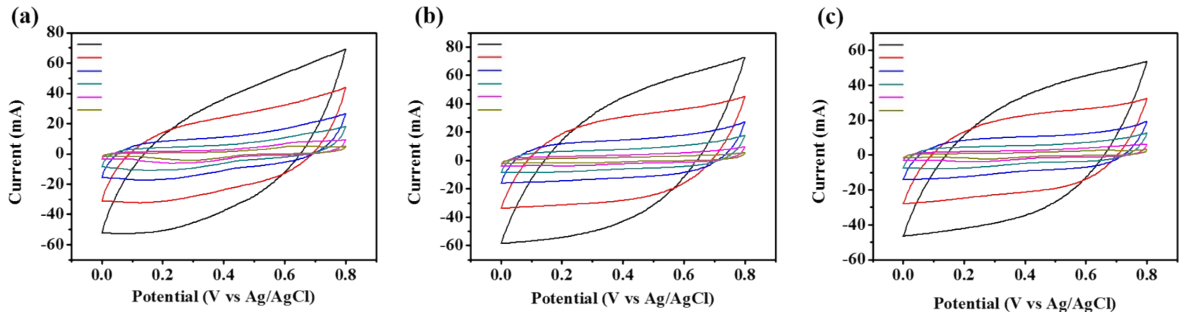

Figure S1. Cyclic voltammetry (CV) curves for (a) $Mn_2O_3/Mn_3O_4/MnO@C$, (b) MnO@C and (c) MnO_2 electrodes.

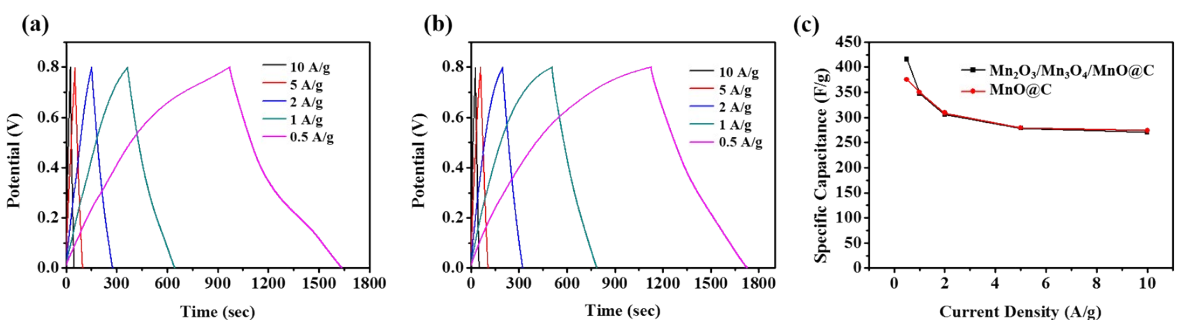

Figure S2. Galvanostatic charge–discharge performances of (a) $Mn_2O_3/Mn_3O_4/MnO@C$-based electrode and (b) MnO@C-based electrode at different current densities. (c) Specific capacitances of $Mn_2O_3/Mn_3O_4/MnO@C$-based electrode and MnO@C-based electrode at different current densities.

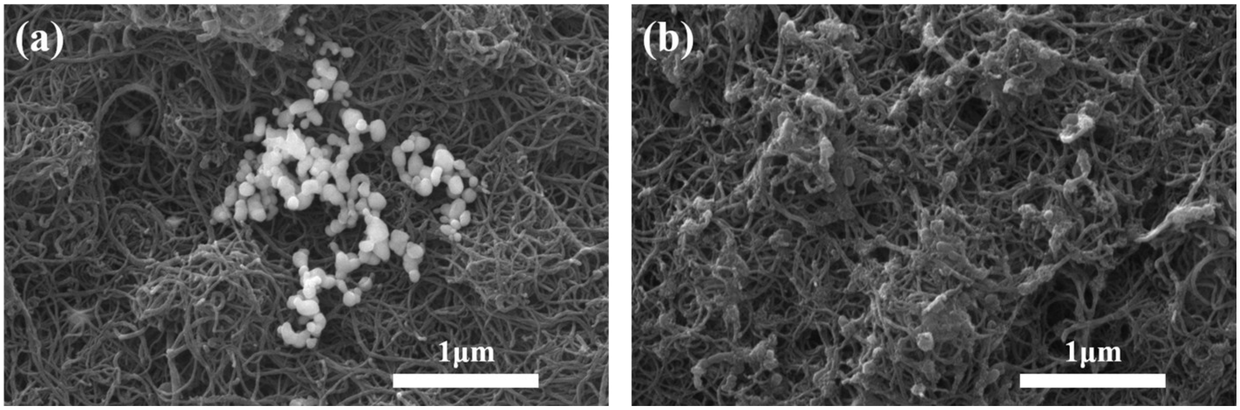

Figure S3. Scanning electron microscope (SEM) image for $Mn_2O_3/Mn_3O_4/MnO@C$, MnO@C electrodes supercapaciators after 5000 times charge-discharge cycling. SEM images of (a) $Mn_2O_3/Mn_3O_4/MnO@C$ and (b) MnO@C electrodes after 5000 times charge-discharge cycling. There are no change of morphology in nanostructure of $MnO_x@C$.

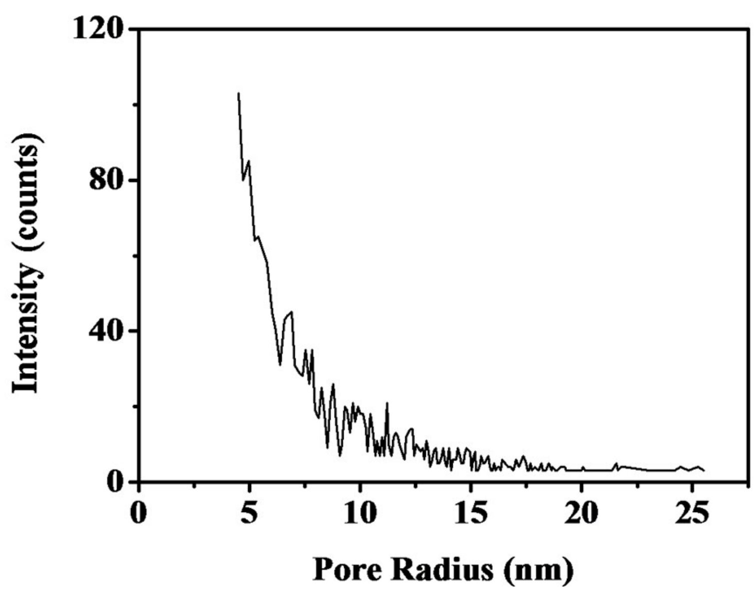

Figure S4. Pore size distribution of $MnO_x@C$, analyzed by ImageJ.