Supporting information

Ultrathin MnO_2 nanoflakes grown on N-doped carbon nanoboxes for high-energy asymmetric supercapacitors

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Part I: Figures

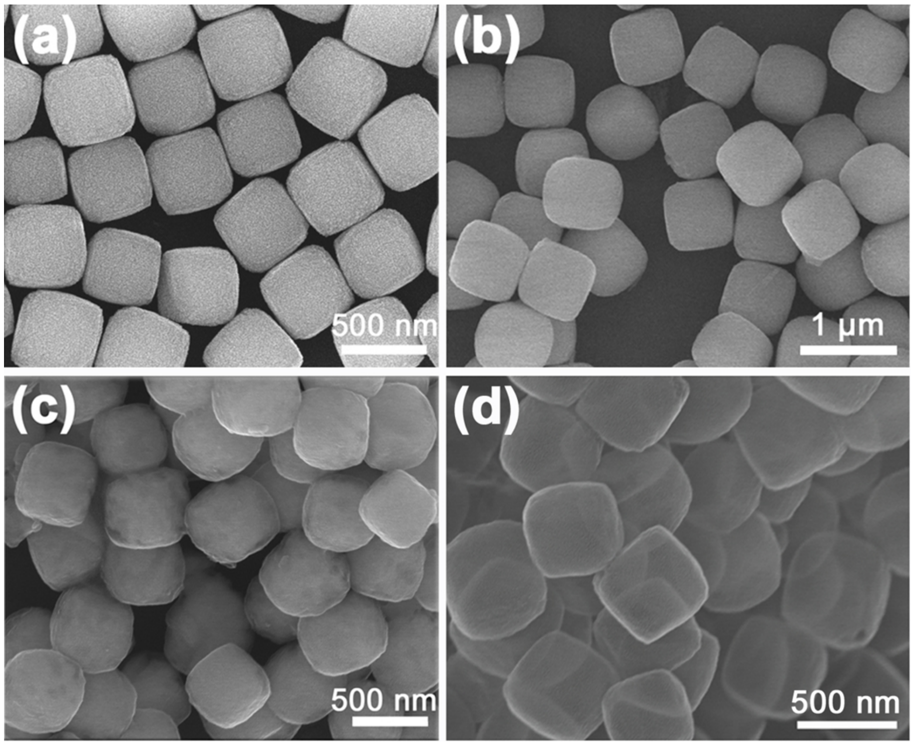

Fig. S1 SEM images of (a) Fe_2O_3 nanocubes, (b) Fe_2O_3@PDA nanocubes, (c) Fe_2O_3@C nanocubes and (d) N-doped carbon nanoboxes.

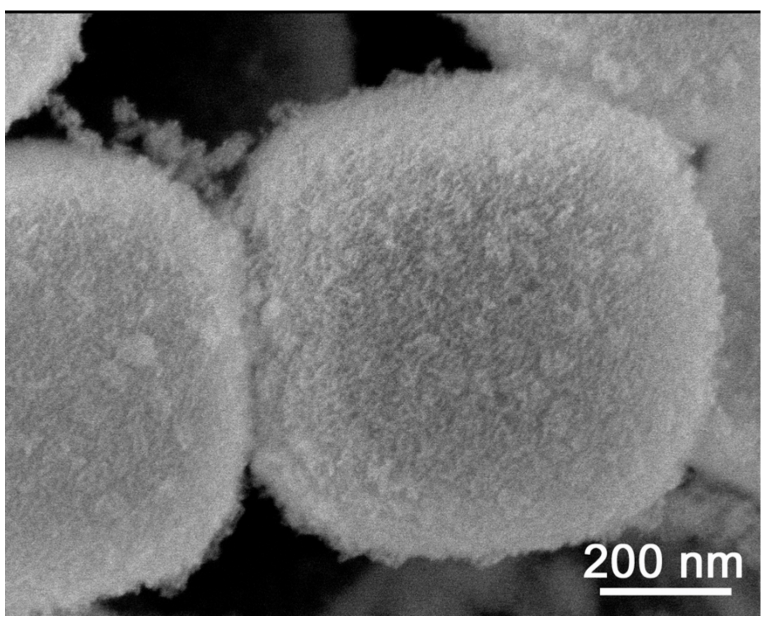

Fig. S2 High-magnification SEM image of a representative MnO_2/C nanobox.

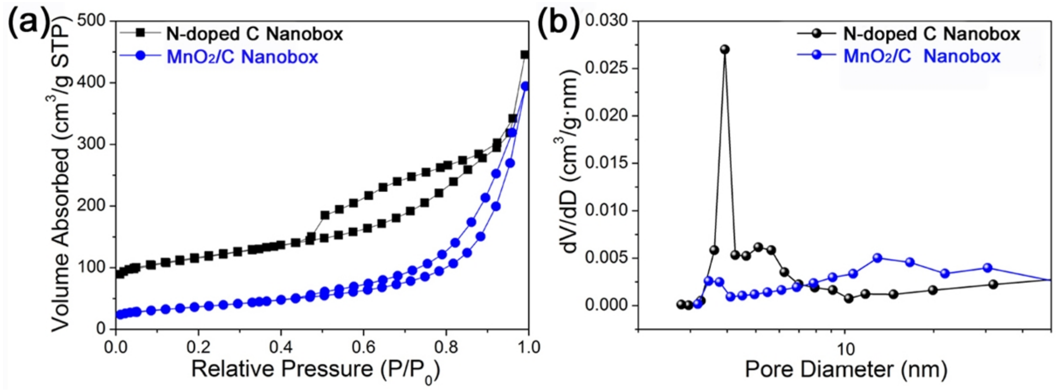

Fig. S3 (a) N_2 adsorption/desorption isotherms and (b) pore size distribution curves of N-doped carbon nanoboxes and MnO_2/C nanoboxes.

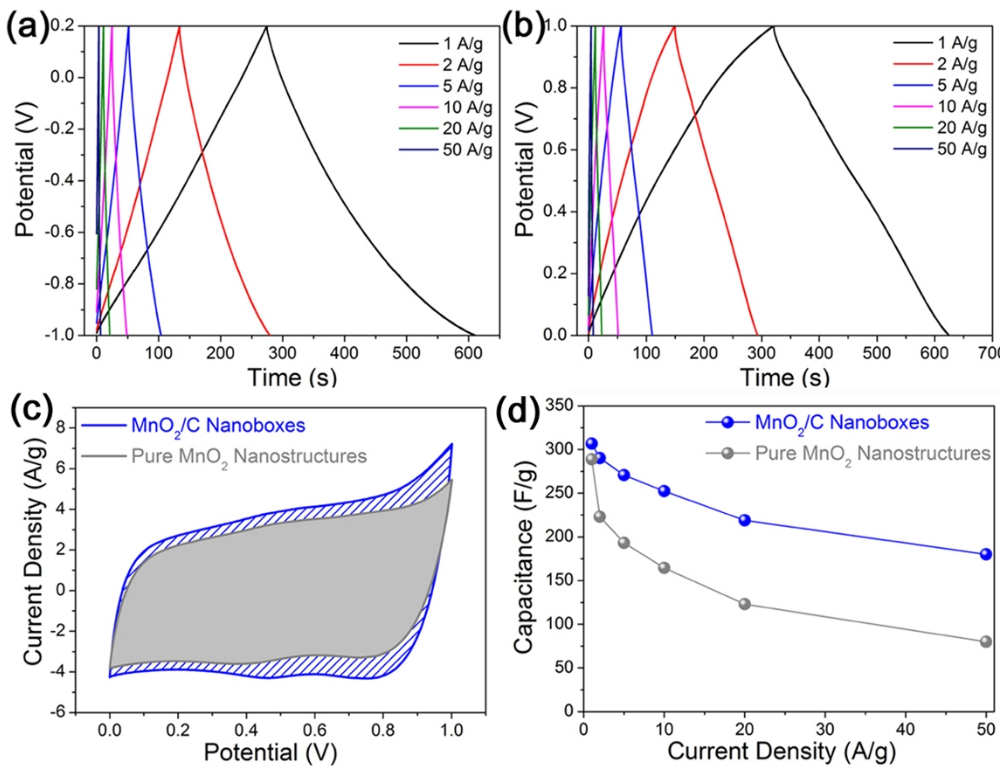

Fig. S4 The galvanostatic charge/discharge curves of (a) the N-doped carbon and (b) the MnO_2/C nanoboxes; (c) CV curves at 20 mV $s^{-1}$and (d) rate performances of the MnO_2/C nanoboxes and the pure ultrathin MnO_2 nanosheets with a three-electrode configuration in a 1 M Na_2SO_4 electrolyte. It is obvious that the as-obtained MnO_2/C nanoboxes deliver a higher specific capacitance than that of pure MnO_2. Furthermore, the CV curve of the MnO_2/C nanoboxes also exhibits an almost vertical line between 0-0.2 V and 0.8-1.0 V compared to the pure MnO_2, suggesting a higher rate capability, which is verified by the test results (Fig. S4d).

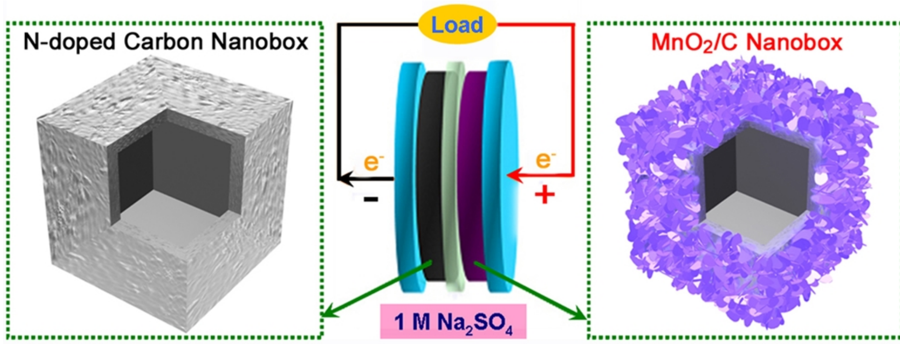

Fig. S5 Schematic illustration of the as-fabricated ASC device based on MnO_2/C nanoboxes as positive electrode and N-doped carbon nanoboxes as negative electrode in 1 M Na_2SO_4 electrolyte.

Part II: Calculations

The specific capacitance was calculated from the CV curve according to the following equation:

$$C = Q/(\Delta V m),$$

where C (F g^{-1}) is the specific capacitance, Q (C) is the average charge during charge/discharge process, m (g) is the mass of active material, and ΔV (V) is the potential window of the CV curve. The discharge specific capacitance could also be calculated from the discharge curves by the following equation:

$$C = I\Delta t/(m\Delta V),$$

where I (A), Δt (s), m (g) and ΔV (V) are the discharge current, discharge time, mass of the active materials (or mass of the total electrode materials), and the potential window, respectively.

The energy density (E, W h kg^{-1}) and power density (P, W kg^{-1}) were calculated by the following equations:

$$E = C(\Delta V)^2/2,$$

$$P = E/\Delta t$$

where C (F g^{-1}) is the specific capacitance of the active materials, and ΔV (V) is the potential window, Δt (s) is the discharge time consumed in the potential range of ΔV.