Electronic Supplementary Information

Hierarchical Heterostructures of MnO_2 Nanosheets or Nanorods Grown on Au-Coated Co_3O_4 Porous Nanowalls for High Performance Pseudocapacitance

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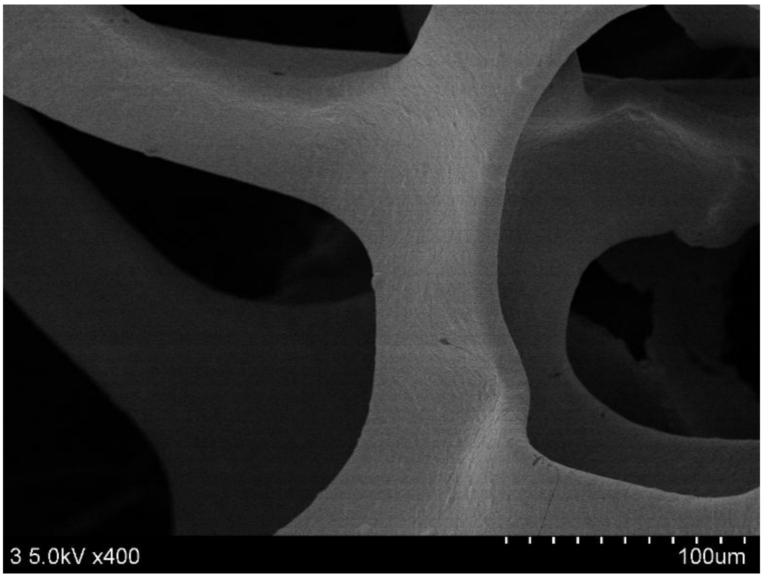

Fig. S1 Low-magnification SEM image showing as-grown Co_3O_4 porous nanowalls on macroporous Ni foam.

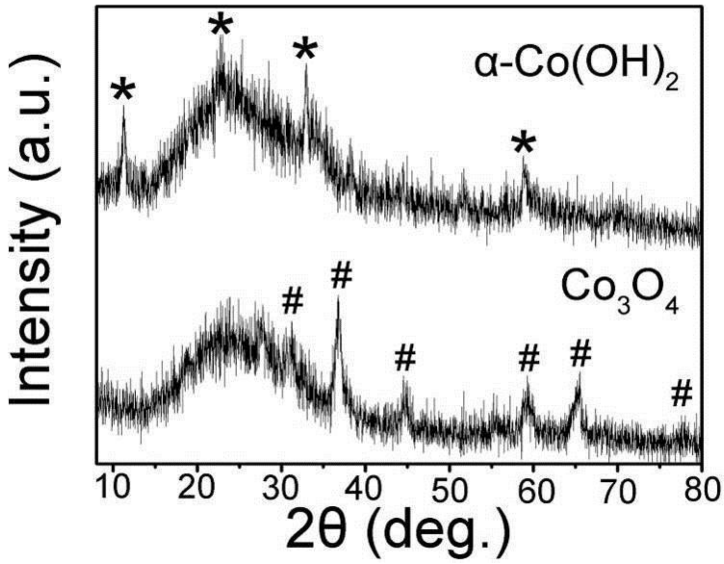

Fig. S2 XRD patterns demonstrate a transformation of $Co(OH)_2$ to Co_3O_4 after thermal annealing at 250 °C. The up pattern matches well with that of hexagonal α-$Co(OH)_2$ phase by referring to JCPDS card (no.: 74-1057),[1] while the bottom pattern can be indexed to that of cubic Co_3O_4 phase by referring to JCPDS card (no.: 43-1003).[2] Here, a broad weak peak (centered at 2θ = ~ 25°) of both patterns is due to glass substrate during the XRD measurements.

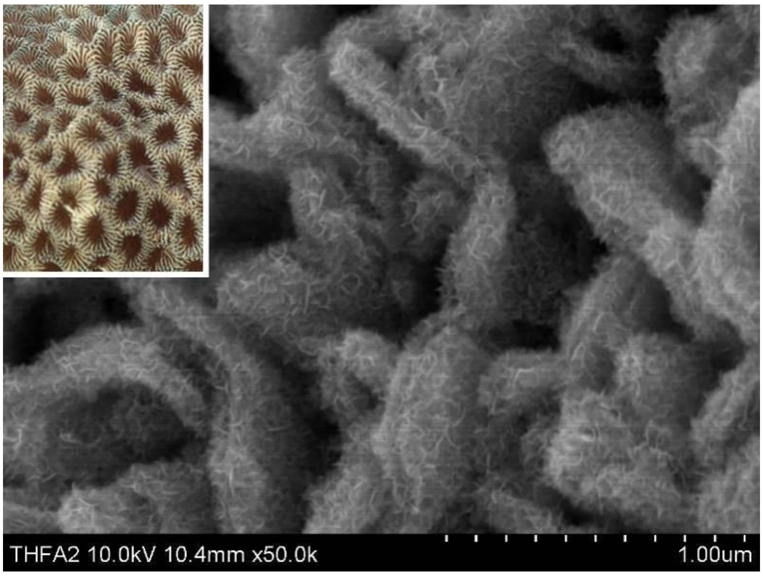

Fig. S3 High-manification SEM image of dense and fine MnO_2 nanosheets grown on the Au-coated Co_3O_4 porous nanowalls, appearing like a kind of coral (an upper-left inset).

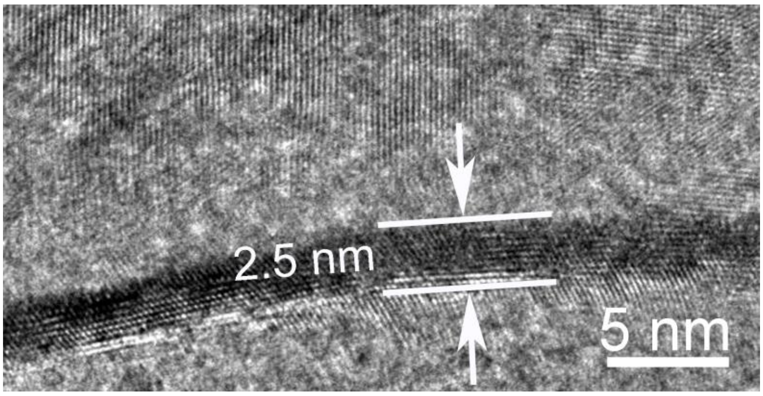

Fig. S4 HRTEM image shows that as-grown MnO_2 nanosheet is as thin as ~ 2-3 nm.

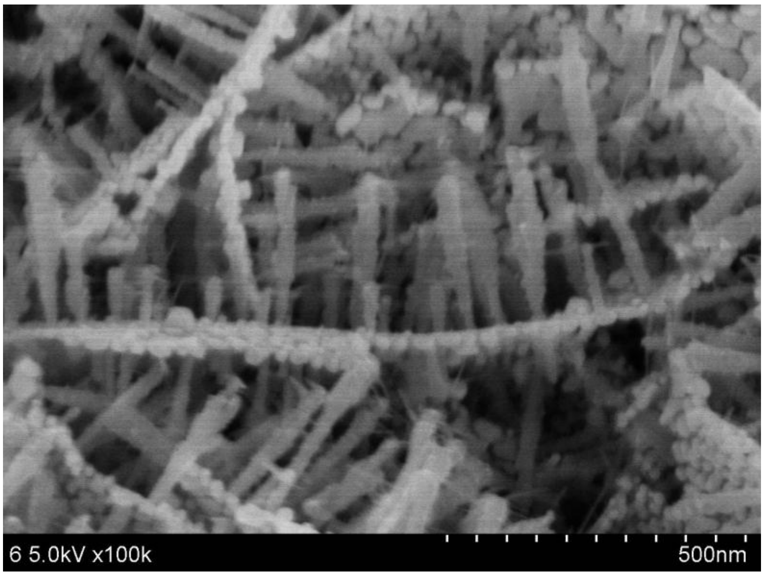

Fig. S5 High-manification SEM image of as-grown MnO_2 nanorods on the Au-coated Co_3O_4 nanowall arrays.

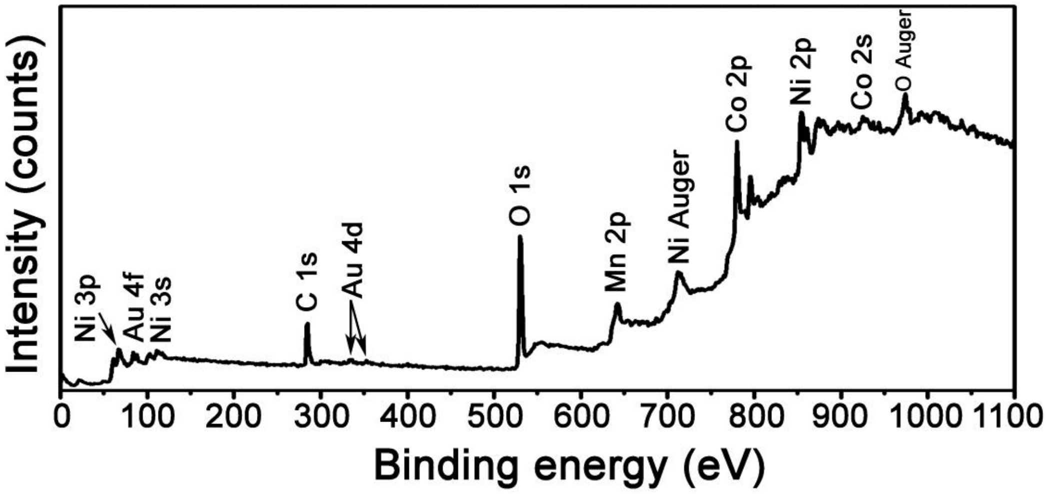

Fig. S6 XPS spectrum acquired from the Co_3O_4@Au@MnO_2(NRs) hierarchical heterostructures.

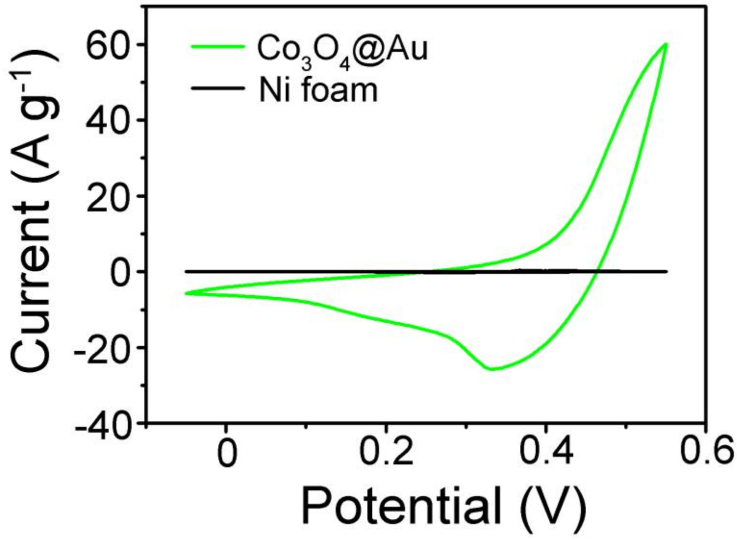

Fig. S7 CV curves recorded from the Ni foam and as-grown Co_3O_4 porous nanowalls, respectively, at a scan rate of 50 mV s^{-1}.

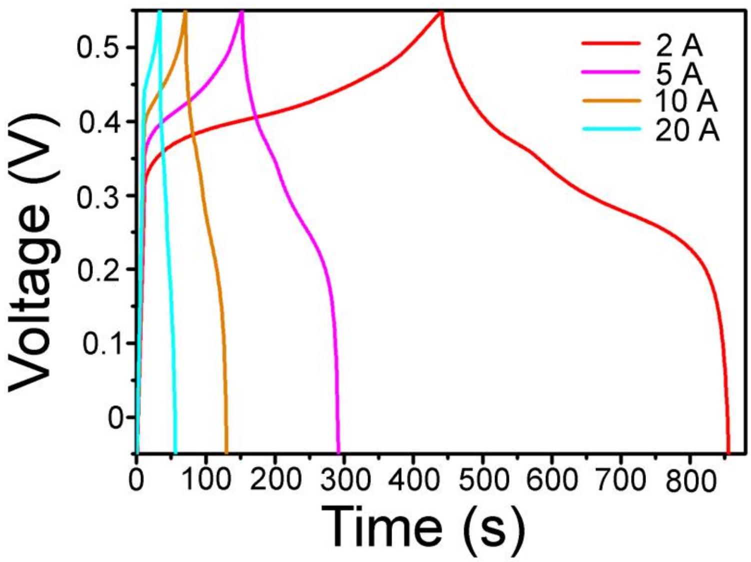

Fig. S8 Galvanostatic charge-discharge curves of the Co_3O_4@Au@MnO_2(NSs) hierarchical heterostructures at different current densities.

Specific capacitance calculation

The specific capacitance of the electrode was calculated from the C-V curves according to the following equation:[3]

$$C = \frac{Q}{\Delta V * m}$$

where C (F g^{-1}) is the specific capacitance, m (g) is the mass of the active materials in the electrodes, Q (C) is an average charge during the charging and discharging processes, and ΔV (V) is the potential window.

The discharge specific capacitance is calculated from the discharge curves using the following formula:[3]

$$C = \frac{I * \Delta t}{m * \Delta V}$$

where I (A), Δt (s), m (g), and ΔV (V) are the discharge current, discharge time consumed in the potential range of ΔV, mass of the active materials, and the potential windows, respectively.

The power density and energy density are calculated from the following equations, respectively:[3]

$$E = \frac{1}{2} C * \Delta V^2$$

$$P = \frac{E}{t}$$

where P (kW kg^{-1}), C (F g^{-1}), ΔV (V), t (s), and E (W h kg^{-1}) are the power density, specific capacitance, potential window of discharge, discharge time, and energy density, respectively.

Reference

1 T. Zhao, H. Jiang, J. Ma, *J. Power Sources* 2011, **196**, 860.

2 C. Z. Yuan, L. Yang, L. R. Hou, L. F. Shen, X. G. Zhang, X. W. Lou, *Energy Environ. Sci.* 2012, **5**, 7883.

3 J. Yan, E. Khoo, A. Sumboja, P. S. Lee, *ACS Nano* 2010, **4**, 4247.