Electronic supplementary information

1. Electrochemical measurements employed in present work.

➢ Measurements conducted in a three-electrode system using 6 mol L^{-1} KOH as electrolyte:

A mixture of 80 wt% the carbon sample (~ 4 mg), 15 wt% acetylene black and 5 wt% polytetrafluoroethylene (PTFE) binder was fabricated using ethanol as a solvent. Slurry of the above mixture was subsequently pressed onto nickel foam under a pressure of 20 MPa, serving as the current collector. The prepared electrode was placed in a vacuum drying oven at 120 ºC for 24 h. A three electrode experimental setup taking a 6 mol L^{-1} KOH aqueous solution as electrolyte was used in cyclic voltammetry and galvanostatic charge-discharge measurements on an electrochemical working station (CHI660D, ChenHua Instruments Co. Ltd., Shanghai). Here, the prepared electrode, platinum foil (6 cm^2) and saturated calomel electrode (SCE) were used as the working, counter and reference electrodes, respectively.

Specific capacitances derived from galvanostatic tests can be calculated from the equation:

where C (F g^{-1}) is the specific capacitance; I (A) is the discharge current; Δt (s) is the discharge time; ΔV (V) is the voltage window; and m (mg) is the mass of active materials loaded in working electrode.

Specific capacitances derived from cyclic voltammetry tests can be calculated from the equation:

$$C = \frac{1}{mv(V_b - V_a)} \int_{V_a}^{V_b} I \mathrm{d}V$$

where C (F g^{-1}) is the specific capacitance; m (mg) is the mass of active materials loaded in working electrode; v (V s^{-1}) is the scan rate; I (A) is the discharge current; V_b and V_a (V) are high and low voltage limit of the CV tests.

➢ Measurements conducted in a two-electrode system using [EMIm]BF_4/AN as electrolyte:

In a two-electrode cell, [EMIm]BF_4 and acetonitrile (AN) (weight ratio of 1:1) was adopted as electrolyte. A glassy paper separator was sandwiched between two electrodes, and each electrode contains a mixture of 80 wt% the carbon sample (~ 2 mg), 15 wt% acetylene black and 5 wt% polytetrafluoroethylene (PTFE) binder. Nickel foam serves as the current collector. The assembly of the test cell was done in a glove box filled with Ar.

Specific capacitances derived from galvanostatic tests can be calculated from the equation:

$$C = \frac{4I\Delta t}{m\Delta V}$$

where C (F g^{-1}) is the specific capacitance; I (A) is the discharge current; Δt (s) is the discharge time; ΔV (V) is the voltage window; and m (g) is the total mass of two electrodes.

Specific capacitances derived from cyclic voltammetry tests can be calculated from the equation:

$$C = \frac{2}{mv(V_b - V_a)} \int_{V_a}^{V_b} IdV$$

where C (F g^{-1}) is the specific capacitance; m (mg) is the mass of active materials

loaded in working electrode; v (V s^{-1}) is the scan rate; I (A) is the discharge current; V_b and V_a (V) are high and low voltage limit of the CV tests.

Specific energy density (E) and specific power density (P) derived from galvanostatic tests can be calculated from the equations:

$$E = \frac{1}{8} C \Delta V^2$$

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

where E (Wh kg^{-1}) is the average energy density; C (F g^{-1}) is the specific capacitance; ΔV (V) is the voltage window; P (W kg^{-1}) is the average power density and Δt (s) is the discharge time.

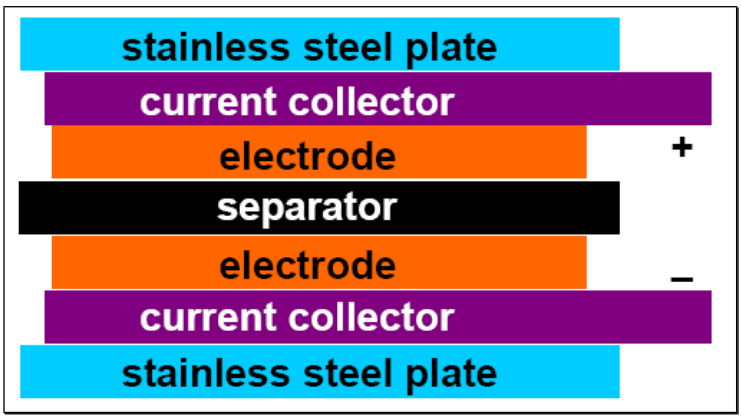


Fig. S1. Schematic illustration of a supercapacitor cell.

Table S1. Carbon samples obtained under different reaction conditions.

No.	Samples	Starting materials with different mass ratios	Carbonization temperature / °C
1.	**Zinc-800**	Zn-complex	800
2.	**Zinc-900**	Zn-complex	900
3.	**Zinc-1000**	Zn-complex	1000
4.	**Zinc metal-1:1-900**	zinc metal + Zn-complex (1:1)	900
5.	**Zinc metal-2:1-900**	zinc metal + Zn-complex (2:1)	900
6.	**Zinc metal-1:2-900**	zinc metal + Zn-complex (1:2)	900
7.	**Mg-800**	Mg-complex	800
8.	**Mg-900**	Mg-complex	900
9.	**Mg-1000**	Mg-complex	1000
10.	**Ca-800**	Ca-complex	800
11.	**Ca-900**	Ca-complex	900
12.	**Ca-1000**	Ca-complex	1000
13.	**Al-800**	Al-complex	800
14.	**Al-900**	Al-complex	900
15.	**Al-1000**	Al-complex	1000

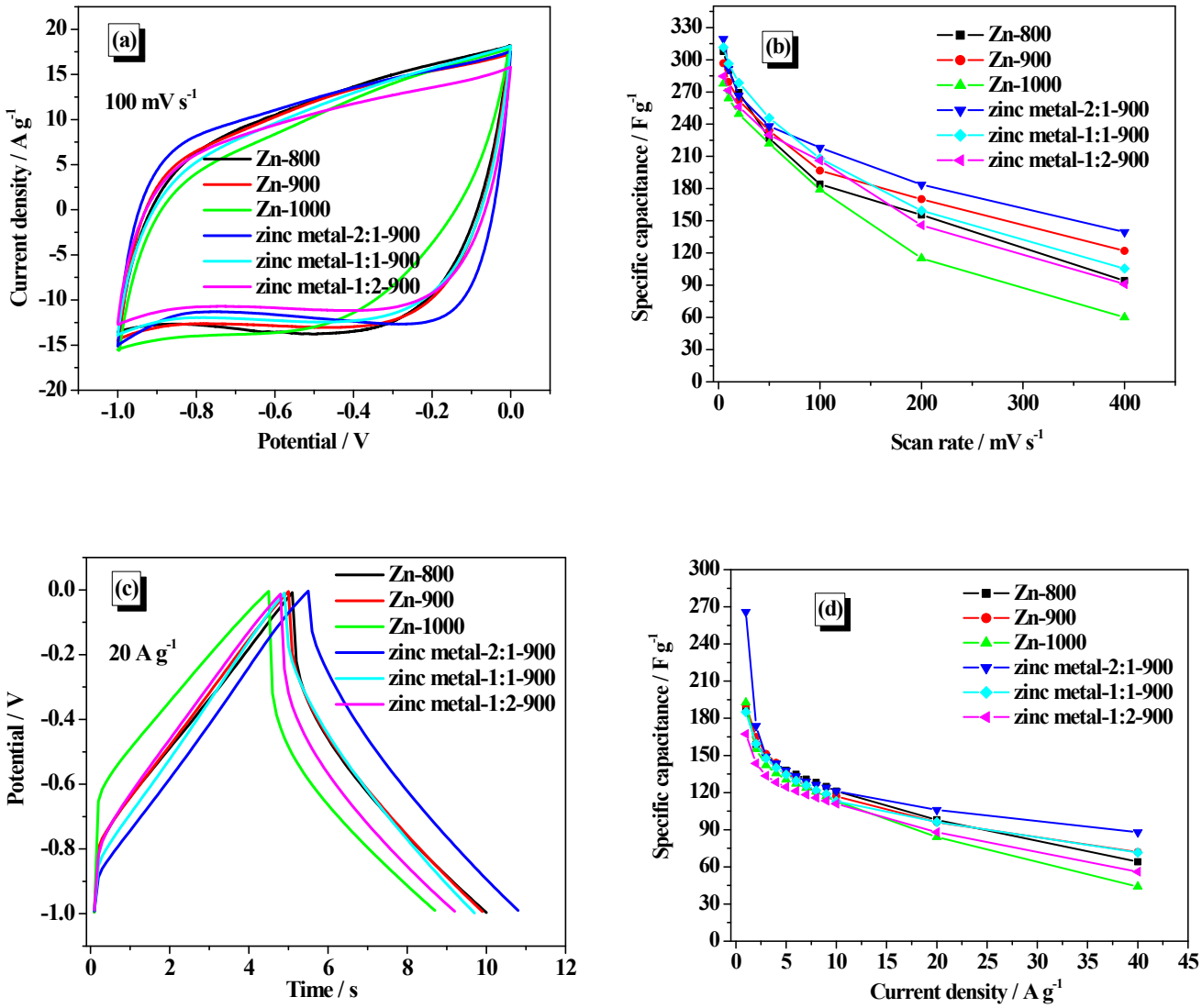


Fig. S2. Carbon samples measured in a **three-electrode system** using 6 mol L^{-1} KOH as electrolyte: (a) CV curves at a scan rate of 100 mV s^{-1}; (b) specific capacitances calculated from CV curves; (c) GCD curves at a current density of 20 A g^{-1}; (d) specific capacitances calculated from GCD curves.

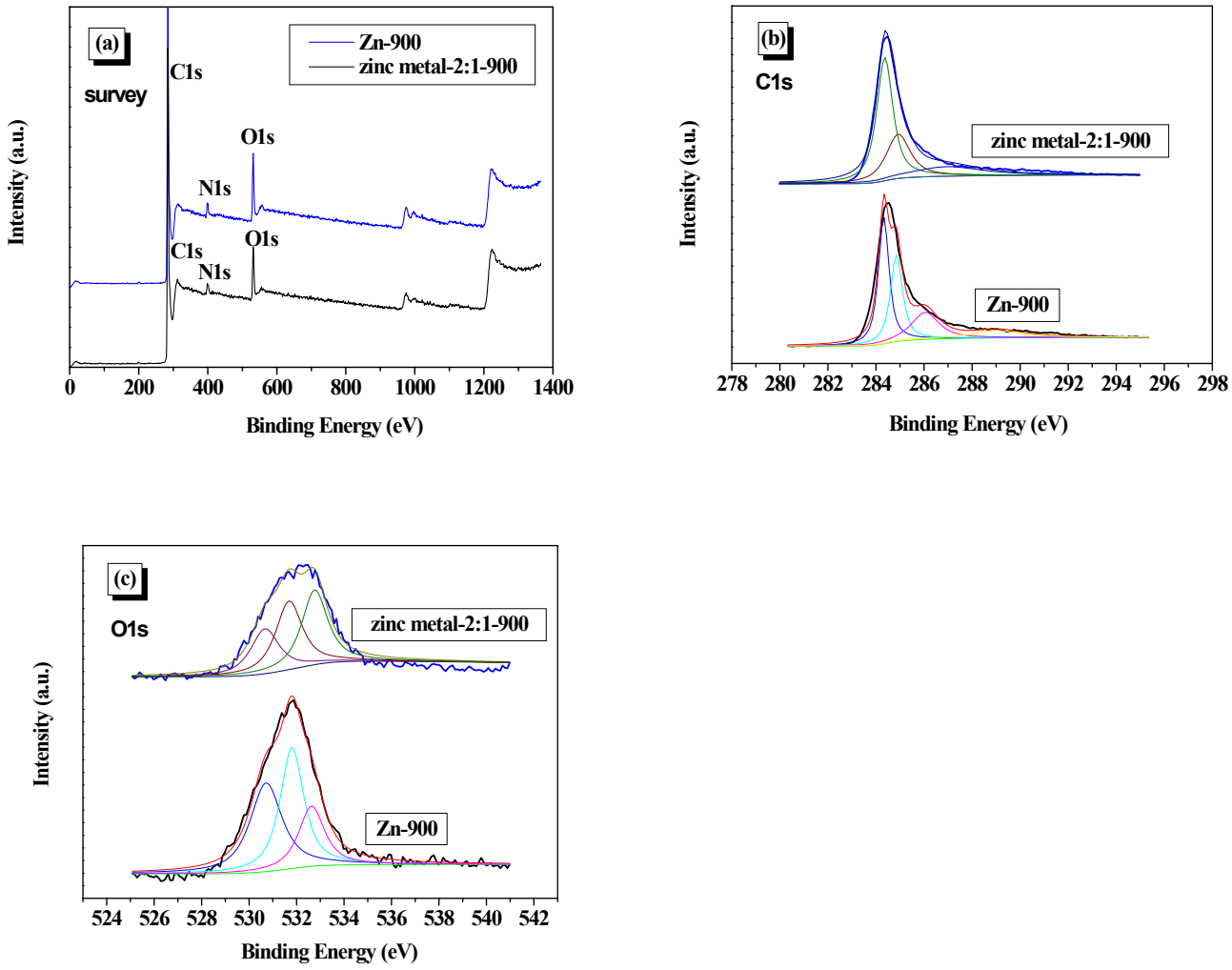


Fig. S3. Zn-900 and **zinc metal-2:1-900** samples: (a) XPS survey spectra; (b) C1s; (c) O1s.

Table S2. XPS peak analysis of the carbon samples.

Sample	C (*at.* %)	N (*at.* %)	O (*at.* %)
Zn-900	88.88	3.14	7.98
zinc metal-2:1-900	90.08	3.63	6.29

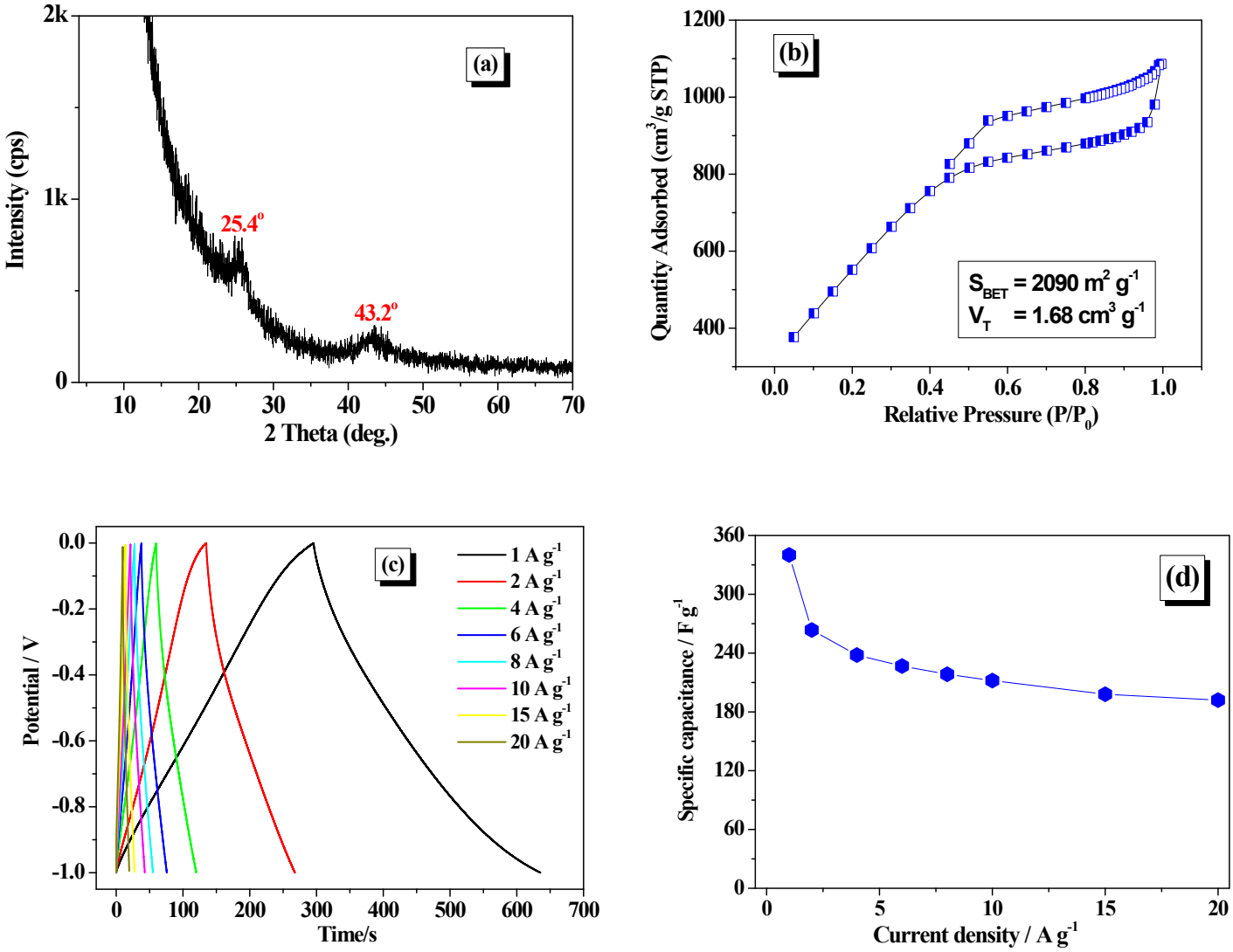
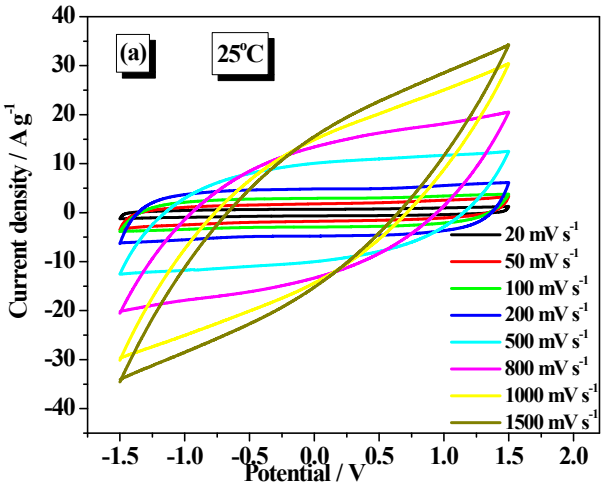
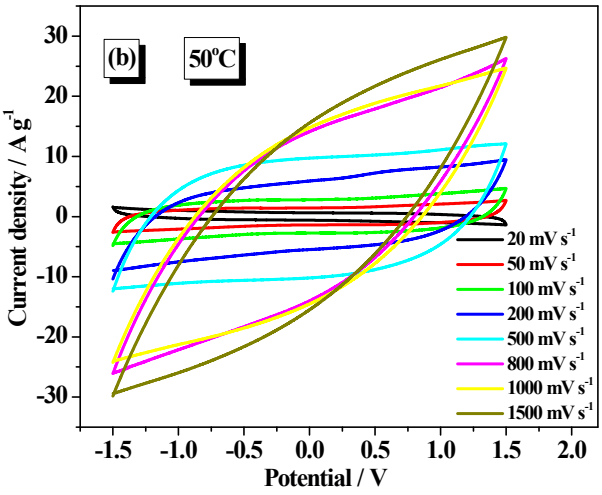
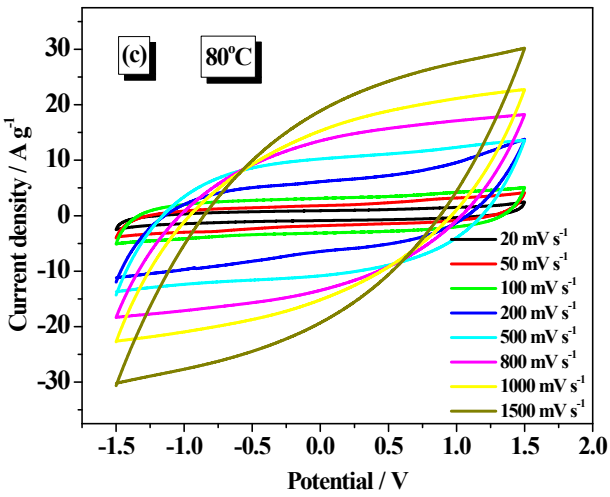
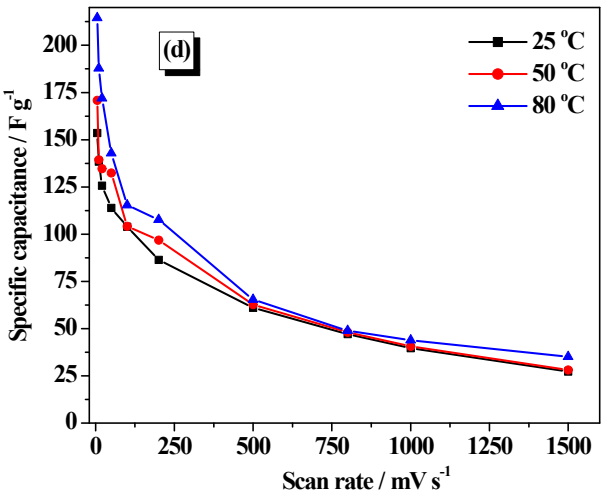


Fig. S4. Commercially available activated carbon: (a) XRD pattern; (b) N_2 adsorption-desorption isotherms and pore size distribution; (c) GCD curves at different current densities; (d) specific capacitances calculated from GCD curves.


(a)
25°C
Current density / A g-1
Potential / V
20 mV s-1
50 mV s-1
100 mV s-1
200 mV s-1
500 mV s-1
800 mV s-1
1000 mV s-1
1500 mV s-1


(b)
50°C
Current density / A g-1
Potential / V
20 mV s-1
50 mV s-1
100 mV s-1
200 mV s-1
500 mV s-1
800 mV s-1
1000 mV s-1
1500 mV s-1


(c)
80°C
Current density / A g-1
Potential / V
20 mV s-1
50 mV s-1
100 mV s-1
200 mV s-1
500 mV s-1
800 mV s-1
1000 mV s-1
1500 mV s-1


(d)
Specific capacitance / F g-1
Scan rate / mV s-1
25 °C
50 °C
80 °C

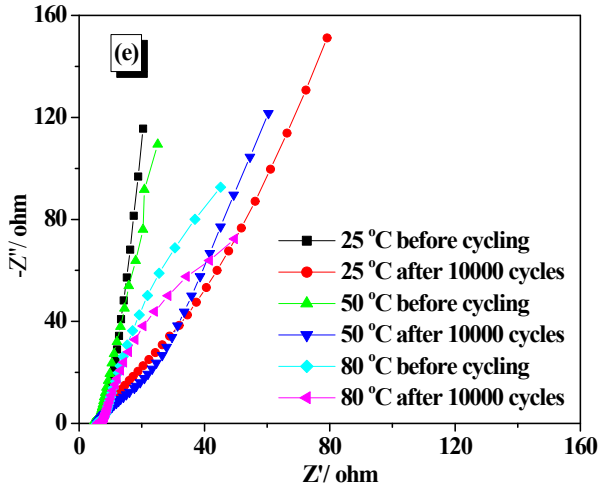
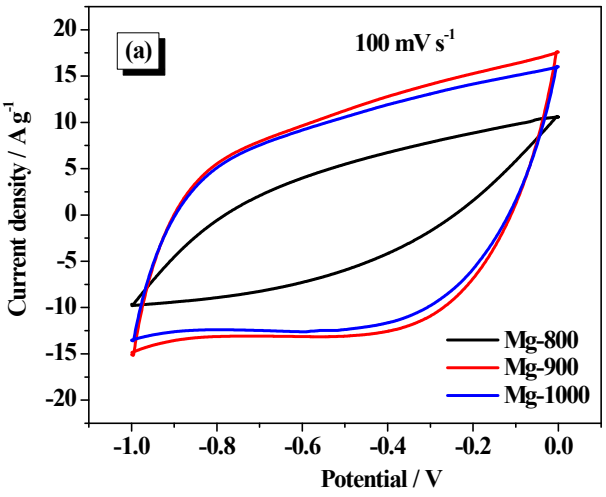
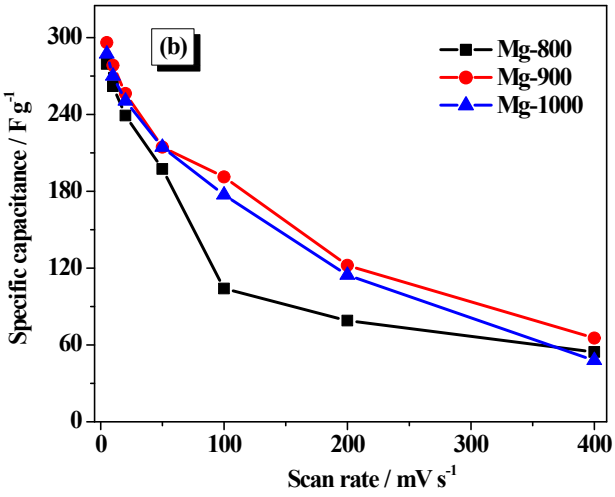
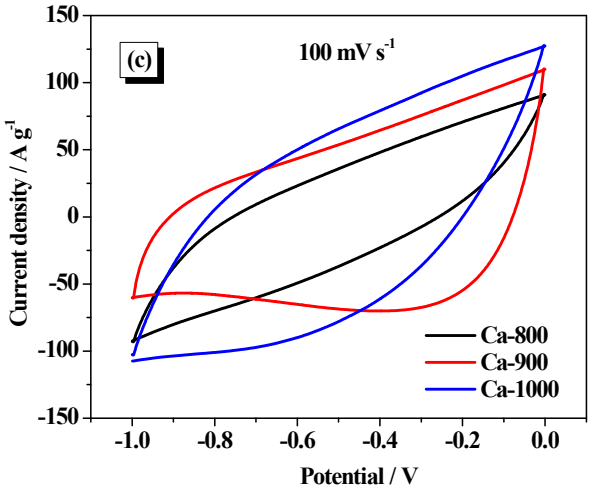
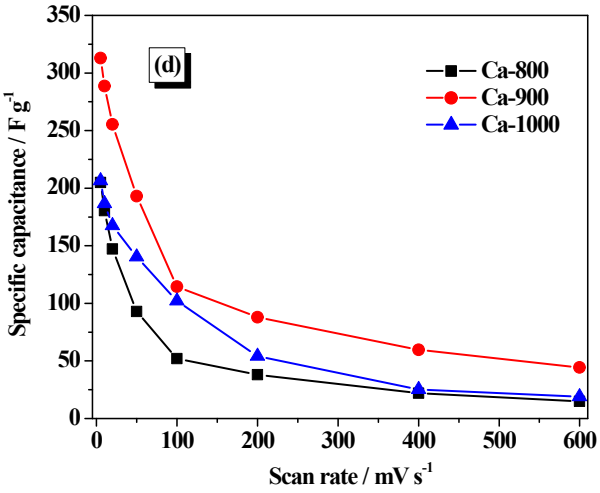

(e)
-Z'' / ohm
Z' / ohm
25 °C before cycling
25 °C after 10000 cycles
50 °C before cycling
50 °C after 10000 cycles
80 °C before cycling
80 °C after 10000 cycles

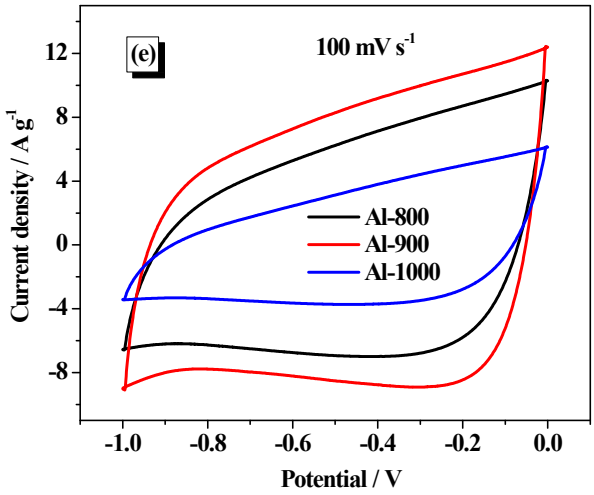
Fig. S5. Zinc metal-2:1-900 sample measured in a **two-electrode system** using [EMIm]BF_4/AN as electrolyte at the operation temperatures of 25/50/80 °C: (a-c) CV curves at various scan rates; (d) specific capacitances calculated from CV curves; (e) Nyquist plots before/after 10000 cycles.


(a)
100 mV s-1
Mg-800
Mg-900
Mg-1000
Current density / A g-1
Potential / V


(b)
Mg-800
Mg-900
Mg-1000
Specific capacitance / F g-1
Scan rate / mV s-1


(c)
100 mV s-1
Ca-800
Ca-900
Ca-1000
Current density / A g-1
Potential / V


(d)
Ca-800
Ca-900
Ca-1000
Specific capacitance / F g-1
Scan rate / mV s-1


(e)
100 mV s-1
Al-800
Al-900
Al-1000
Current density / A g-1
Potential / V

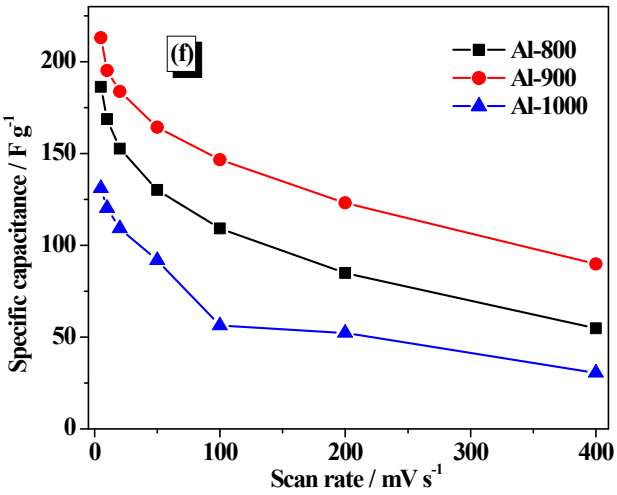

(f)
Al-800
Al-900
Al-1000
Specific capacitance / F g-1
Scan rate / mV s-1

Fig. S6. Mg/Ca/Al-800/900/1000 samples measured in a **three-electrode system** using 6 mol L^{-1} KOH as electrolyte: (a, c, e) CV curves at a scan rate of 100 mV s^{-1}; (b, d, f) specific capacitances calculated from CV curves.

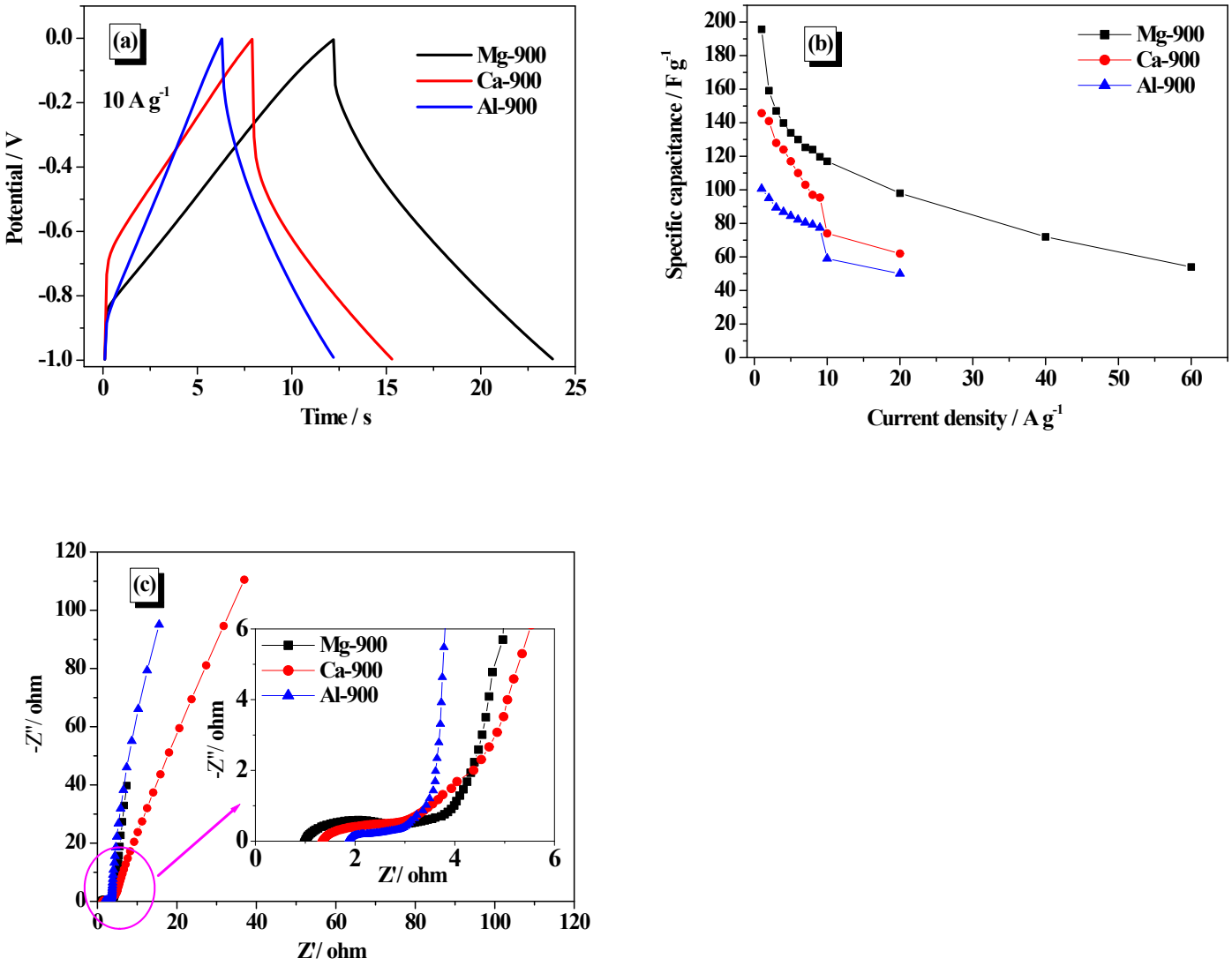


Fig. S7. Mg/Ca/Al-900 samples measured in a three-electrode system using 6 mol L^{-1} KOH as electrolyte: (a) GCD curves at a current density of 10 A g^{-1}; (b) specific capacitances calculated from GCD curves; (c) Nyquist plots after 10000 cycles, as well as the magnified ones (the inset).

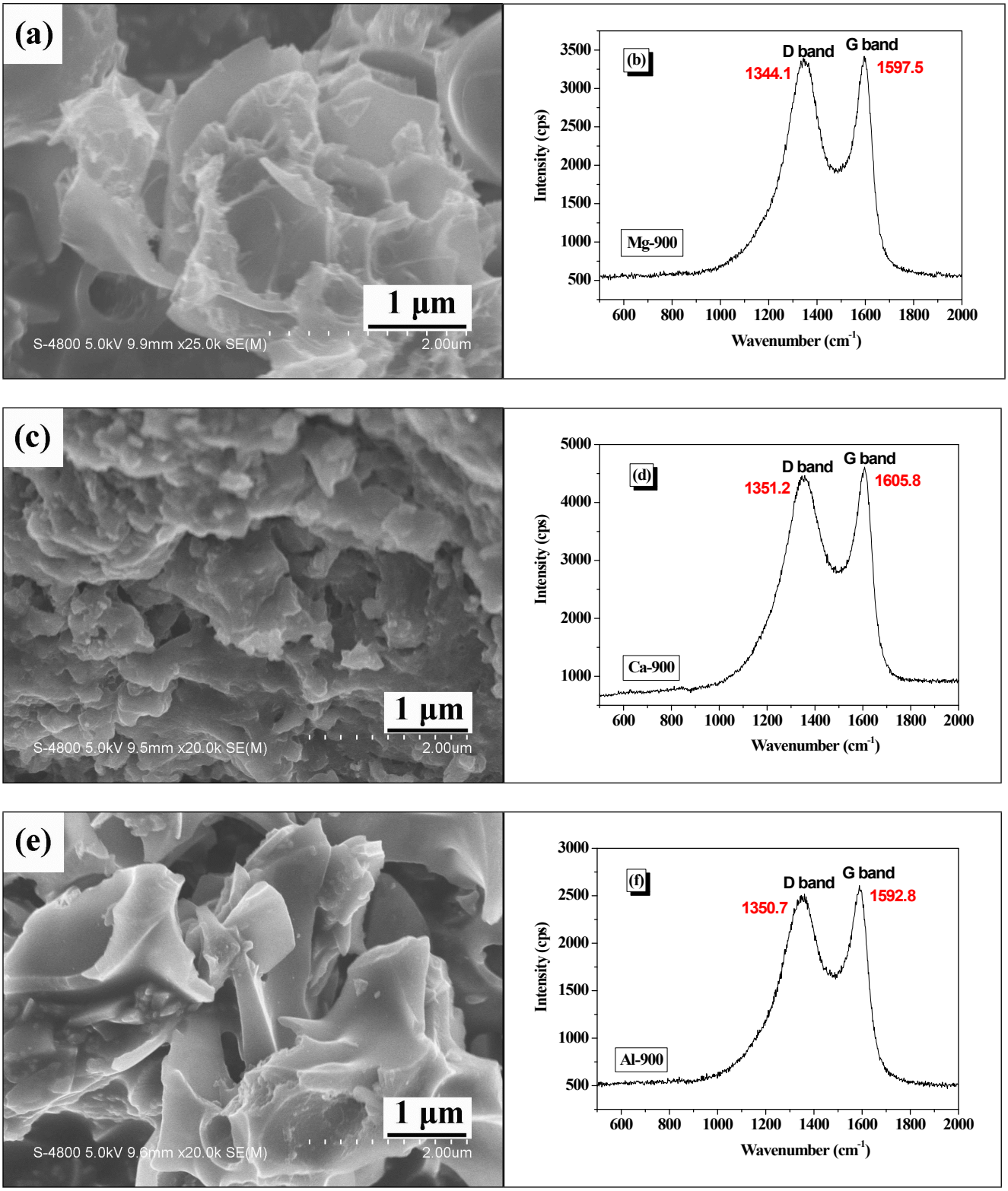


Fig. S8. FESEM images and Raman spectra: (a-b) **Mg-900**; (c-d) **Ca-900**; (e-f) **Al-900**.