Supporting Information for

KCu_7S_4 Nanowires and Mn/KCu_7S_4 Nanostructure For Solid-state Supercapitors

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Content:

The contents of Supporting Information includes the following:

(1) Electrochemical characterization of Mn/KCu_7S_4 hybrid ECs.

(2) SEM image of the cross-sectional view of the Mn/KCu_7S_4 hybrid ECs after reaction and its mechanism of the ion conduction.

(3) The screen of three supercapacitor units to light 400 light-emitting diodes (LEDs).

(4) The calculation method of the specific capacitance, energy density and power density of Mn/KCu_7S_4 hybrid ECs.

(5) The CV curves of KCu_7S_4 nanowires ECs (150 ^oC) with different potential window and the SEM image of Mn nanoparticle.

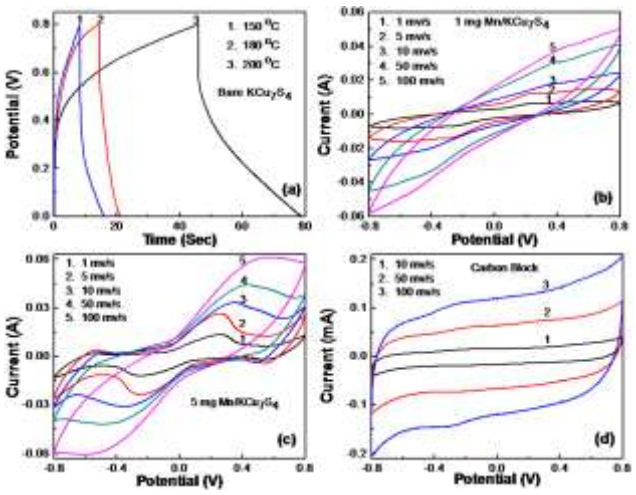

Fig. S1 (a) Galvanostatic charging/discharging curves for KCu_7S_4 hybrid ECs at a fixed current of 5 mA with different synthesis temperature of 150 ^oC, 180 ^oC and 200 ^oC. (b), (c) Cyclic voltammetry(CV) curves for Mn/KCu_7S_4 hybrid ECs at different scan rates ranging from 1 to 100 mV s^{-1} with different Mn nanoparticles coating quality of 1 and 5 mg. (d) Cyclic voltammetry curves for bare carbon hybrid ECs at different scan rates from 10 to 100 mV s^{-1}

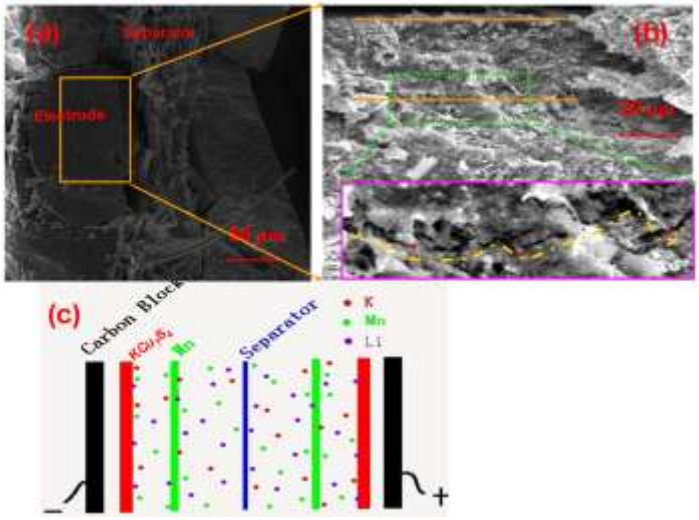

Fig. S2 SEM image of the cross-sectional view of the Mn/KCu_7S_4 hybrid ECs after reaction. The left image (a) shows the sandwich of the Mn/KCu_7S_4 hybrid ECs after reaction. The right image (b) shows the high-magnification SEM image of the Mn/KCu_7S_4 hybrid ECs of (a). (c) Schematic of mechanism of the Mn/KCu_7S_4 hybrid ECs ion conduction.

Fig. S3 The screen of three supercapacitor units (based on coating 2 mg Mn/KCu_7S_4 hybrid ECs) in series to light 400 light-emitting diodes (LEDs) well about 2 min.

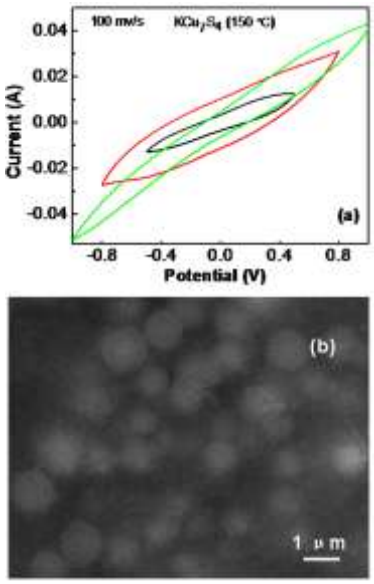

Fig. S4 (a) The CV curves of KCu_7S_4 nanowires ECs (150 ^oC) with different potential window at a scan rate of 100 mV s^{-1}. (b) The SEM image of Mn nanoparticle.

The average specific capacitance of Mn/KCu_7S_4 hybrid ECs can be calculated from the CV curves by integrating the area under the current potential curve,[1]

$$C_s = \frac{1}{MV(V_a - V_c)} \int_{v_a}^{v_c} I(v)dV \qquad (1)$$

and $$C_s = \frac{I\Delta t}{M\Delta V} = \frac{I}{M\frac{dv}{dt}} \qquad (2)$$

M is the effective mass of Mn/KCu_7S_4 hybrid ECs in the reaction, which is calculated by 1/5 Mn/KCu_7S_4 film mass (The weight of KCu_7S_4 electrode is about 20.03 g (including to Carbon Block (C) and bare KCu_7S_4), the weight of the bare KCu_7S_4 is about 30 mg. M is Mn/KCu_7S_4 hybrid ECs of the effective mass in the reaction, which is calculated by 1/5 Mn/KCu_7S_4 film mass.The reason is as following: the figure S2 shows the cross-sectional view of

the Mn/KCu_7S_4 hybrid EC after reaction, and the inset in S2 (b) is the corresponding higher resolution SEM image. From the inset image, we can see the reaction of the split, which divide the part of reaction into that of no reaction. (Please see Figure S2). So we can know that only a thin layer of Mn/KCu_7S_4 hybrid ECs (about 1/5 Mn/KCu_7S_4 hybrid ECs mass) take a reaction in charge/discharge process.). Figure S2 shows the cross-sectional view of the Mn/KCu_7S_4 hybrid EC after reaction. From Figure S2, we can know that only a thin layer of Mn/KCu_7S_4 hybrid ECs (about 1/5Mn/KCu_7S_4 hybrid ECs mass) take a reaction in charge/discharge process. dv/dt is the voltage scan rate. **W**hen capacitance C is a constant, when capacitance C is a constant, the current I is proportional to the voltage scan rate dv/dt.

The energy density is calculated by the function $E=1/2C_sV^2_{mas}$, and the power density is calculated by the function $V^2_{mas}/4MR_s$.

Reference

[1] S. K. Meher, P. Justin and G. Ranga Rao, ACS Appl. Mater. Interfaces, 2011, 3, 2063–2073.