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# Supporting Information

## Modified chemical synthesis of MnS nanoclusters on nickel foam for high-performance all-solid-state asymmetric supercapacitors

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**Equation for calculating the specific capacitance from the CV data**

$$C_s = \frac{\int_{V_1}^{V_2} i dV}{(V_2 - V_2)\nu m} \quad \text{(S1)}$$

where $C_s$ is the specific capacitance, i is the current response to the given voltage V, $V_1$ is the lower potential limit,$V_2$ is the upper potential limit, ν is the scan rate, and m is the mass of electrode (g).

**Equation for calculating the specific capacitance from the charge-discharge data**

$$C_S = \frac{I \cdot \Delta t}{m \Delta V}, \quad \text{(S2)}$$

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where $C_s$ is the specific capacitance (F $g^{-1}$), I is the discharge current (A), m is the mass of electrode (g), and ΔV is the potential window (V).

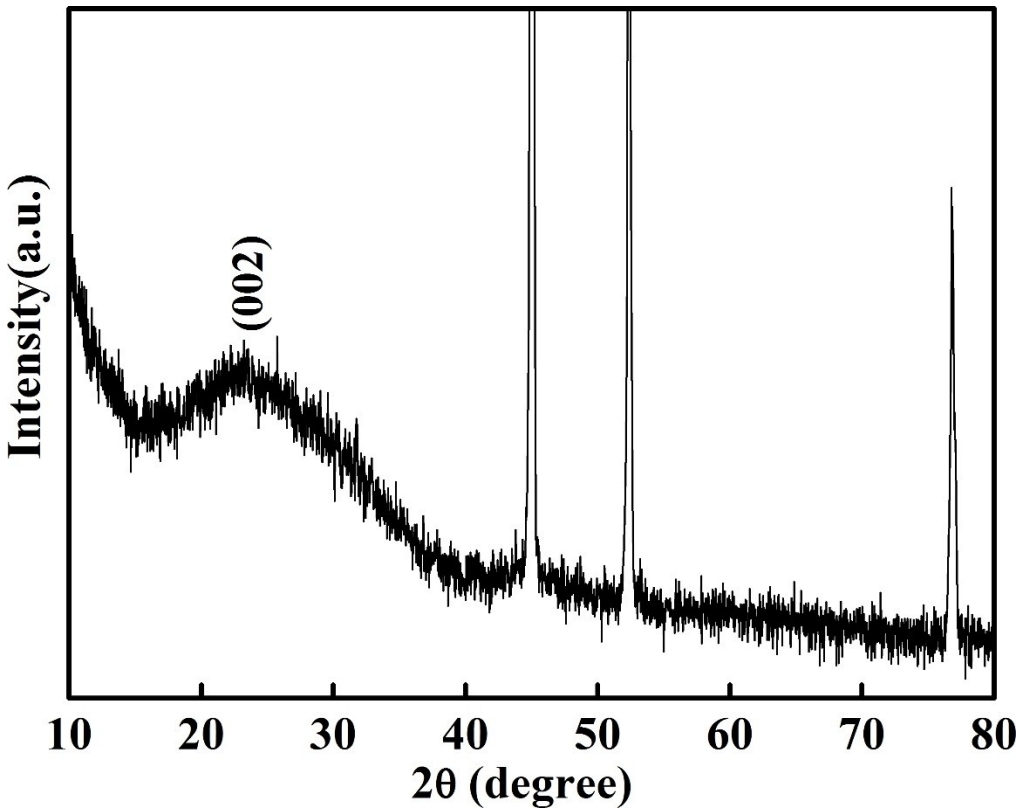


**Fig. S1. XRD pattern of the hydrothermally reduced GO.**

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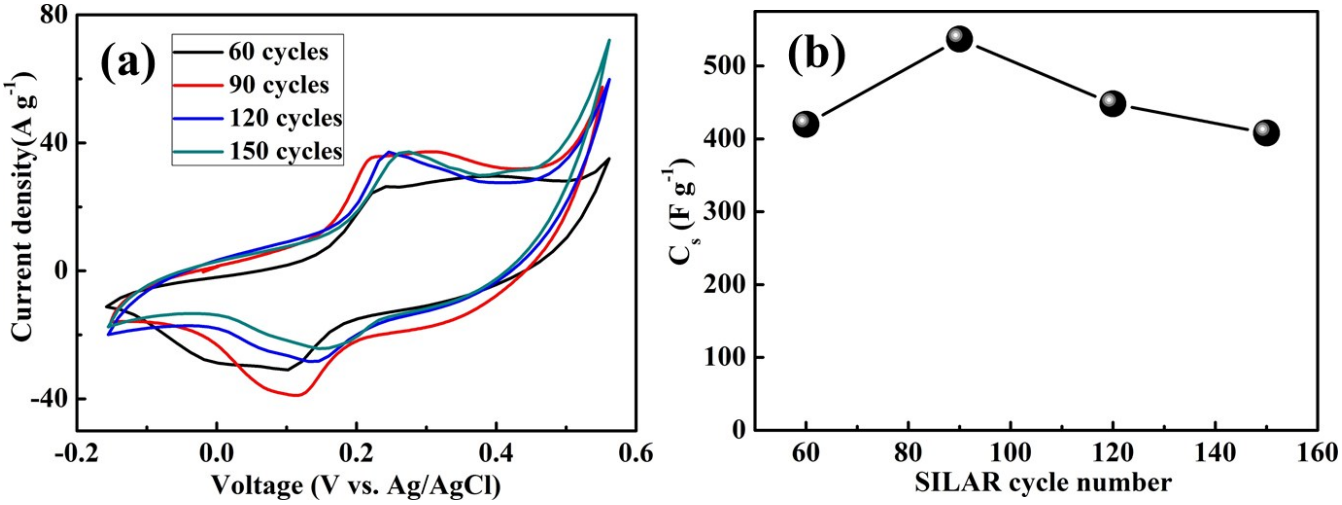


**Fig. S2. (a) CV curves of MnS@NF electrodes at a fixed scan rate of 100 mV $s^{-1}$ in 6M KOH and (b) their variation of $C_s$ upon the number of SILAR cycles.**

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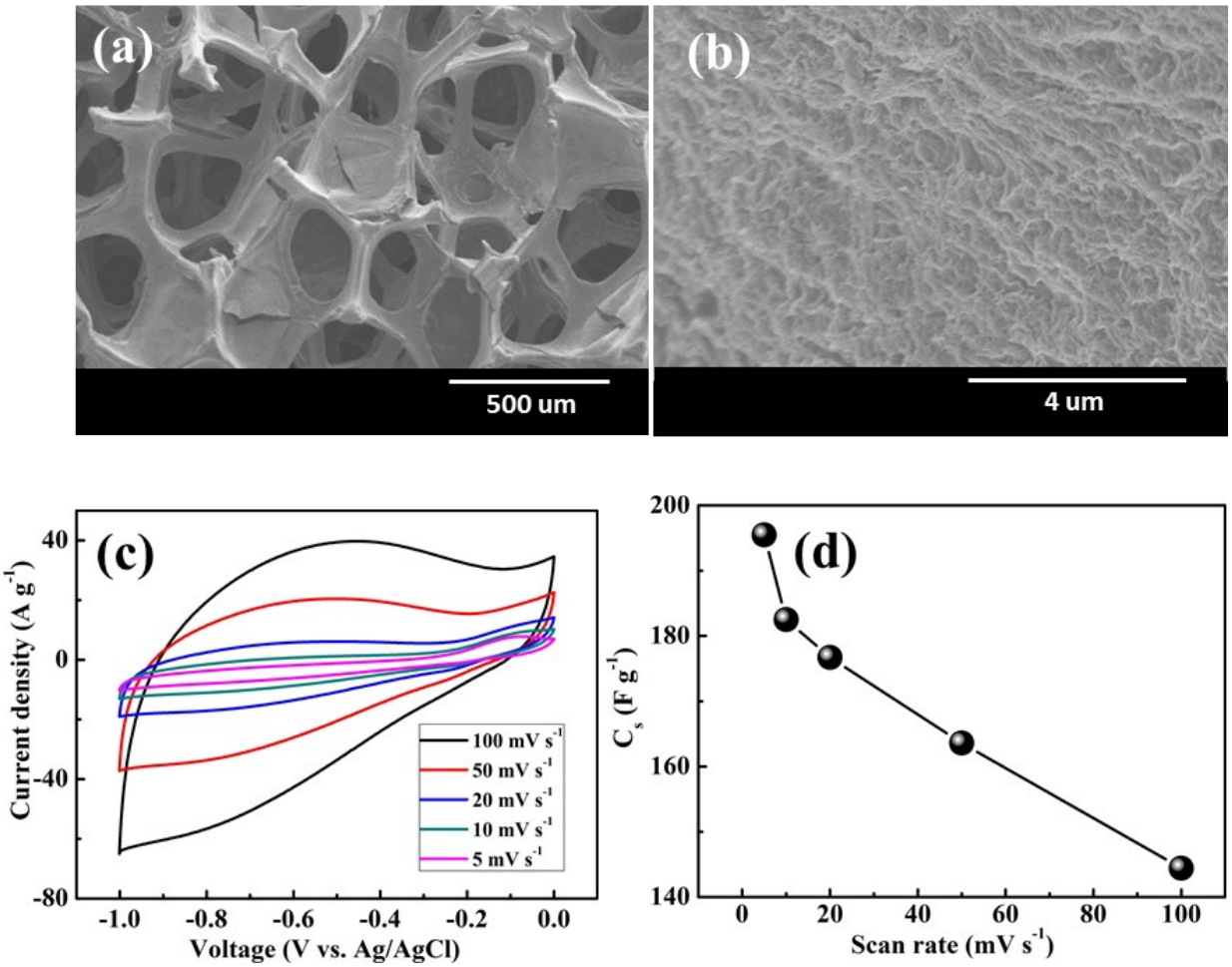


**Fig. S3. (a, b) FE-SEM images of the hydrothermally reduced GO on NF, (c) CVs of rGO@NF electrode in 6 M KOH at various scan rates, and (d) the variation of $C_s$ of rGO@NF as a function of the scan rate.**

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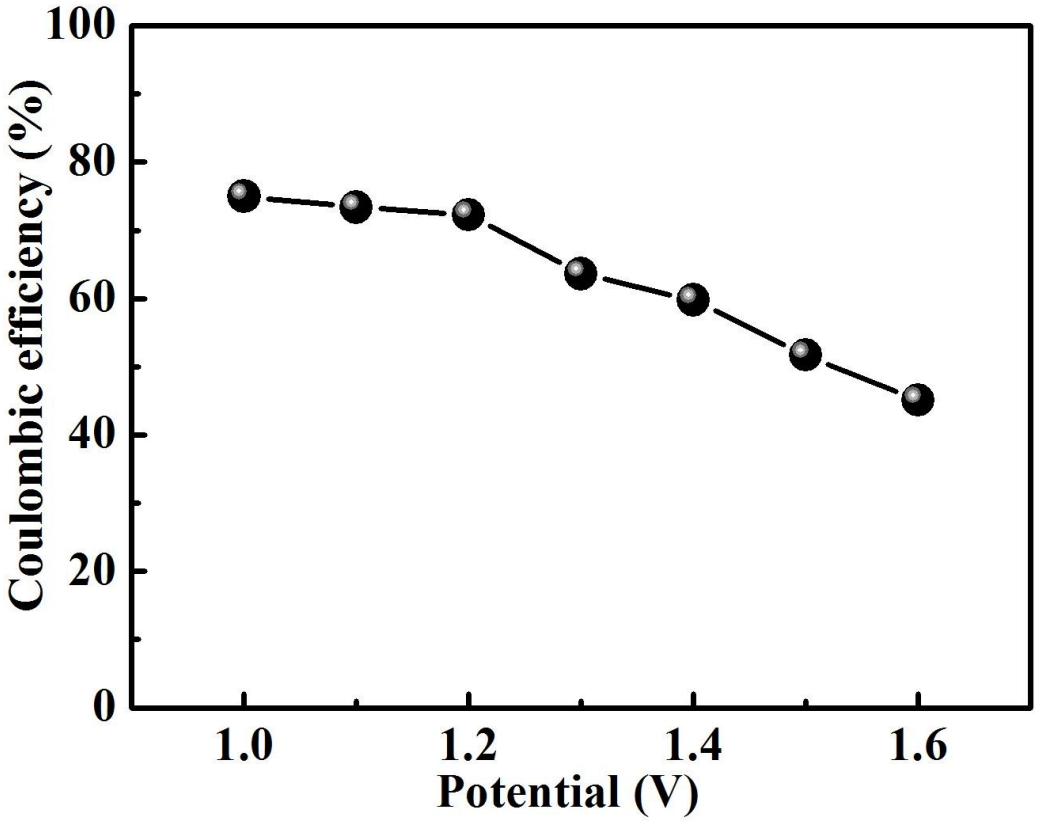


**Fig. S4 Coulombic efficiency of the MnS@NF//rGO@NF ASC at various potential windows.**

**Table S1. Parameter values for fitting the Nyquist plots of the as-prepared MnS@NF electrode before cycling and after 5000 cycles in a 3 electrode system.**

| Parameter | Before cycling | Parameter | After 5000 cycles |
|---|---|---|---|
| C (mF) | 0.49 | C' (mF) | 0.50 |
| $R_s$ (Ω) | 0.48 | $R'_s$ (Ω) | 0.63 |
| $R_{ct}$ (Ω) | 1.20 | $A'_{w1}$ (Ω $s^{-0.5}$) | 14.2 |
| $A_w$ (Ω $s^{-0.5}$) | 65.6 | $A'_{w2}$ (Ω $s^{-0.5}$) | 99.5 |
| $W_{or}$ (Ω $s^{-0.5}$) | 15.5 | - | - |
| $W_{oc}$ (Ω $s^{-0.5}$) | 0.082 | - | - |

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**Table S2. Parameter values for fitting the Nyquist plots of the as-prepared**

| Parameter | Before cycling | Parameter | After 2000 cycles |
|---|---|---|---|
| $R_s$ (Ω) | 0.72 | $C'_1$ (mF) | 1.40 |
| $R_{ct1}$ (Ω) | 1083 | $C'_2$ (mF) | 1.19 |
| $R_{ct2}$ (Ω) | 12.4 | $R'_s$ (Ω) | 1.66 |
| $P_1$ | 0.00019 | $R'_{ct}$ (Ω) | 2078 |
| $n_1$ | 0.78 | $A'_w$ (Ω $s^{-0.5}$) | 4947 |
| $P_2$ | 0.00029 | - | - |
| $n_2$ | 0.63 | - | - |

**MnS@NF//rGO@NF ASC before cycling and after 2000 cycles.**

**Table S3. Comparison of the energy and power densities of different MnS-based asymmetric supercapacitors**

| Ref. No. | Symmetric/Asymmetric supercapacitor | | Electrolyte | Potential window (V) | $C_s$ (F $g^{-1}$) | Highest energy density (Wh $kg^{-1}$) | Highest power density (kW $kg^{-1}$) |
|---|---|---|---|---|---|---|---|
| | Positive electrode | Negative electrode | | | | | |

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|---|---|---|---|---|---|---|---|
| 1. | MnS nanocrystals | Activated carbon | KOH agar gel | 0 ~ 1.6 | 110.4 F $g^{-1}$ at 1 A $g^{-1}$ | 37.6 | 5.9 |
| 2. | Tetrapod nanorod MnS nanocrystals | Activated carbon | 2 M KOH aqueous | 0 ~ 1.6 | 59.8 F $g^{-1}$ at 1 mV $s^{-1}$ | 13.1 | 4.45 |
| 3. | α-MnS/ N-doped rGO | Nitrogen-doped rGO | 3 M KOH aqueous | 0 ~ 1.6 | 77.9 F $g^{-1}$ at 1 A $g^{-1}$ | 27.7 | 20 |
| 4. | MnS/GO-$NH_3$ | Activated carbon | 2 M KOH aqueous | 0 ~ 1.6 | 73.6 F $g^{-1}$ at 1 mV $s^{-1}$ | 14.9 | 4.6 |
| 5. | MnS microfibers | MnS microfibers | PVA-KOH gel | -0.6 ~ 0.6 | 68.3 F $g^{-1}$ at 3 mA | 18.9 | 0.25 |
| **6.** | **MnS nanoclusters (This work)** | **rGO** | **PVA-KOH gel** | **0 ~ 1.6** | **104 F $g^{-1}$ at 5 mV $s^{-1}$** | **34.1** | **12.8** |

**References:**


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