Electronic Supporting Information

**Fig. S1.** The fabrication process for (MoS$_2$/CF)@MoS$_2$@C.

**Fig. S2.** The element spectra calculated from EDS mapping (inset) of the (MoS$_2$/CF)@MoS$_2$@C.
**Fig. S3.** (a) TEM and (b) HRTEM images of CF@MoS$_2$@C; low-resolution SEMs of (c) MoS$_2$/CF and (d) (MoS$_2$/CF)@MoS$_2$@C.
Fig. S4. High resolution XPS spectra of (a-c) MoS$_2$/CF, (d-f) (MoS$_2$/CF)@MoS$_2$, (g-i) (MoS$_2$/CF)@MoS$_2$@C, and (j-l) CF@MoS$_2$@C: (a, d, g, j) C 1s, (b, e, h, k) S 2p, and (c, f, i, l) Mo 3d.
Fig. S5. (a, c, e) BET nitrogen adsorption and desorption isotherms, and (b, d, f) pore size distributions of (a, b) MoS$_2$/CF, (c, d) (MoS$_2$/CF)@MoS$_2$, and (e, f) CF@MoS$_2$@C.
As shown in Figure S4, the TGA curve of (MoS$_2$/CF)@MoS$_2$@C is mainly divided into three parts in the temperature range of 80 to 800 °C:

1. Evaporation of water below 200°C (m(H$_2$O)).

\[ m_1(\text{wt.\%}) \text{ (record from the y-axis, 98.3 wt.\%) = } m((\text{MoS}_2/\text{CF})@\text{MoS}_2@\text{C}) \text{ – } m(\text{H}_2\text{O}) \ldots (\text{S1}) \]

2. The oxidation of MoS$_2$ to MoO$_3$ in the temperature range of 300 - 500°C and the gasification of carbon (m$_c$), also occurring in this temperature region.

\[ m_2(\text{wt.\%}) \text{ (record from the y-axis, 66.6 wt.\%) = } m(\text{MoO}_3) = M(\text{MoO}_3) \times n(\text{MoO}_3) \ldots \ldots (\text{S2}) \]

3. The evaporation of MoO$_3$ in air above 680°C.

As a result, the MoS$_2$ content of (MoS$_2$/CF)@MoS$_2$@C is estimated by

\[ \frac{m ((\text{MoS}_2/\text{CF})@\text{MoS}_2@\text{C})}{(m_1(\text{wt.\%}) \times M(\text{MoS}_2))} \times 100 \text{ wt.\%} = \frac{(m_2(\text{wt.\%}) \times M(\text{MoO}_3) \times M(\text{MoS}_2))}{m_1(\text{wt.\%}) \times 100 \text{ wt.\%}} = (66.6 / 144 \times 160) / 98.3 \times 100 \text{ wt.\%} = 75.3 \text{ wt.\%} \]
Fig. S7. CV curves of (a) MoS$_2$/CF, (b) (MoS$_2$/CF)@MoS$_2$ and (c) CF@MoS$_2$@C electrodes for SIBs at a scan rate of 0.1 mV s$^{-1}$ for the initial 3 cycles.
**Fig. S8.** SEM images of samples: (a) MoS$_2$/CF, (b) (MoS$_2$/CF)@MoS$_2$; (c) CF@MoS$_2$@C and (d) (MoS$_2$/CF)@MoS$_2$@C electrodes after 200 cycles.

**Fig. S9.** Comparison of EIS spectra of the (MoS$_2$/CF)@MoS$_2$@C electrode in the (a) SIBs and (b) DIBs.
Fig. S10. CV curve of graphite in SIB measured at 0.2 mV s\(^{-1}\) in the voltage range of 2.0 - 5.0 V.
**Table S1.** Elemental composition of (MoS$_2$/CF)@MoS$_2$@C obtained by EDX analysis.

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<tr>
<th>Element</th>
<th>Weight percentage (%)</th>
<th>Atomic Percentage (%)</th>
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<tbody>
<tr>
<td>Carbon</td>
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<td>Oxygen</td>
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<tr>
<td>Molybdenum</td>
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<td>13.45</td>
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<tr>
<td>Sulfur</td>
<td>30.43</td>
<td>27.78</td>
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