Coaxial CoMoO$_4$ Nanowire Arrays with Chemically Integrated Conductive Coating for High-Performance Flexible All-Solid-State Asymmetric Supercapacitors

(Electronic Supplementary Information)

Yaping Chen,$^a$ Borui Liu,$^b$ Qi Liu,$^a,^*$ Jun Wang,$^a,^c,^*$ Zhanshuang Li,$^a$ Xiaoyan Jing,$^a$ and Lianhe Liu,$^a,^c$

$a$ Key Laboratory of Superlight Material and Surface Technology, Harbin Engineering University, Harbin, 150001, P.R. China. E-mail: zhqw1888@sohu.com

$b$ Department of Mechanical Engineering, The University of Texas at Austin, Austin, TX, 78712, United States.

$c$ Institute of Advanced Marine Materials, Harbin Engineering University, 150001, PR China.

* Corresponding author.

I. Cyclic Voltammograms of Different Electrode Materials

![Cyclic voltammograms for PPy/CC and pristine CC at the scan rate of 50 mV s$^{-1}$.](image)

From the CV curves, we could demonstrate that the pristine collector CC has no significant peak current and very little contribution to the total specific capacitance of the hybrid electrode supercapacitors. In addition, the peak currents of the PPy/CC nanocomposite electrode are more diminutive than those of bare CoMoO$_4$/CC and CoMoO$_4$/PPy/CC electrode, indicating that the conductive PPy wrapping just
enhance electrons/ions transportation, thus considerably improving the specific capacitance.

II. Morphological of After Cycling

![Image of SEM images of CoMoO$_4$ NWs and CoMoO$_4$/PPy hybrid NWs after 2000 cycles, respectively.]

Fig. S2  SEM images of CoMoO$_4$ NWs and CoMoO$_4$/PPy hybrid NWs after 2000 cycles, respectively.

The morphology of the pure CoMoO$_4$ NWs after 2000 cycles is damaging badly compared with fresh CoMoO$_4$ NWs. Meanwhile, the extent of pure CoMoO$_4$ NWs destroyed is more serious than the CoMoO$_4$/PPy core–shell NWs after 2000 cycles, indicating that CoMoO$_4$ NWs encapsulated PPy after 2000 cycles has excellent stable structure and large porous pathways leading to efficient electrons and ions transportation between the electrode and electrolyte during charge-discharge processes. As expected, PPy wrapping on the surface of CoMoO$_4$ NWs is contribution to the cycling-dependent-electrode stable architecture.
III. EIS Plots of CoMoO$_4$/CC and CoMoO$_4$/PPy/CC Electrode After Cycling

![EIS Plots](image)

Fig. S3 EIS plots of CoMoO$_4$ NWs and CoMoO$_4$/PPy hybrid NWs after 2000 cycles, respectively.

IV. Data of Diffusion Coefficients and Warburg Impedance of CoMoO$_4$/CC and CoMoO$_4$/PPy/CC Electrode

![Equivalent Circuit](image)

Fig. S4 Equivalent Circuit based on three-electrode system measurement of CoMoO$_4$ NWs and CoMoO$_4$/PPy hybrid NWs electrode

The fitting results are presented in Fig S4 and Table S1. In the equivalent circuit, the $R_S$ is bulk resistance of the electrochemical system (the intersection of the curve at the real part $Z'$ in the high frequency range). Among all the evaluation parameters, $R_{ct}$ of the CoMoO$_4$ NWs electrode is larger than CoMoO$_4$/PPy hybrid NWs electrode, indicating that the CoMoO$_4$/PPy electrode exhibits a higher rate of charge. Meanwhile, $Z_w$ and $R_s$ of the CoMoO$_4$/PPy hybrid NWs electrode are smaller than the pure CoMoO$_4$ NWs electrode, indicating that the CoMoO$_4$/PPy hybrid NWs electrode exhibits lower diffusion
resistance and bulk resistance than the pure CoMoO$_4$ NWs electrode. In a similar way, the performance of the CoMoO$_4$/PPy hybrid NWs electrode after 2000 cycles is better than the pure CoMoO$_4$ NWs electrode after cycling.

![Graph](image_url)

**Fig. S5** The real part of the Warburg impedance ($Z_{Re}$) versus the square root of frequency ($\omega^{-1/2}$) at open circuit voltage (a) for the fresh CoMoO$_4$ NWs and CoMoO$_4$/PPy hybrid NWs electrode and (b) CoMoO$_4$ NWs and CoMoO$_4$/PPy hybrid NWs electrode after 2000 cycles.

The diffusion coefficients are calculated using the following formulas:

$$Z_{Re} = K + \sigma \omega^{-1/2},$$

which K is a constant corresponding to $R_{ct}$, $\omega$ is the frequency, and $\sigma$ is the Warburg factor which corresponds to the slope of the curve shown in Fig S5. We plot the $Z_{Re}$ to $\omega^{-1/2}$ curve to evaluate the diffusion coefficients. Results demonstrate that diffusion coefficients of fresh CoMoO$_4$/PPy hybrid NWs electrode is larger than the fresh CoMoO$_4$/CC electrode, which indicates that CoMoO$_4$/PPy nanocomposites exhibit a high electronic/ion diffusion coefficient and shorten the diffusion time of electronic/ion to the surface of active materials. Similarly, diffusion coefficients of CoMoO$_4$/PPy hybrid NWs electrode after 2000 cycles are lower than the fresh CoMoO$_4$/PPy hybrid NWs electrode, which maybe the structural damaging of the electrode after cycling leads to reduce the electronic/ion diffusion coefficient.
Table S1 Calculated Values of $R_S (\Omega)$, $C_{DL} (F)$, $Rct (\Omega)$, $Z_w (\Omega)$, and $C_L (F)$ through complex nonlinear least-squares (CNLS) fitting method.

<table>
<thead>
<tr>
<th></th>
<th>$R_S (\Omega)$</th>
<th>$C_{DL} (F)$</th>
<th>$Rct (\Omega)$</th>
<th>$Z_w (\Omega)$</th>
<th>$C_L (F)$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fresh CoMoO$_4$</td>
<td>1.84</td>
<td>0.0267</td>
<td>7.40</td>
<td>0.098</td>
<td>0.0675</td>
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<tr>
<td>Fresh CoMoO$_4$/PPy</td>
<td>1.72</td>
<td>0.0201</td>
<td>6.04</td>
<td>0.05</td>
<td>0.0701</td>
</tr>
<tr>
<td>After 2000 cycles of CoMoO$_4$</td>
<td>3.12</td>
<td>0.0546</td>
<td>8.54</td>
<td>0.20</td>
<td>0.1842</td>
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<tr>
<td>After 2000 cycles of CoMoO$_4$/PPy</td>
<td>2.36</td>
<td>0.0527</td>
<td>7.76</td>
<td>0.12</td>
<td>0.1625</td>
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