Supporting Information

Pt-MoO$_3$-RGO Ternary Hybrid Hollow Nanorod Arrays as High-Performance Catalysts for Methanol Electrooxidation

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Figure S1. SEM image of ZnO NRAs.
**Figure S2.** SEM image of ZnO@MoO$_3$-Pt-RGO composite NRAs. (The core-shell structure of ZnO@MoO$_3$-Pt-RGO NRAs is characterized by the TEM shown in inset).

**Figure S3.** TEM image of a broken MoO$_3$-Pt-RGO hollow nanorod.
Figure S4. TEM image of high dispersive Pt nanocrystals in the walls of Pt-MoO$_3$-RGO HNRAs.

Figure S5. IR spectra measured on Pt-MoO$_3$-RGO HNRAs (black) and RGO HNRAs (red).
**Figure S6.** SEM image of Pt-MoO$_3$ hybrid HNRAs.

**Figure S7.** TEM image of commercial Pt/C catalysts.
Figure S8. CVs of catalysts measured in 0.5 M CH$_3$OH+0.5 M H$_2$SO$_4$ solution at 50 mV/s with specific current density of ECSA.

Figure S9. SEM image of Pt-MoO$_3$-RGO HNRAs after 200 cycles.
Figure S10. CVs of commercial Pt/C catalysts from 1st to 200th cycle.

Figure S11. CVs of Pt-MoO$_3$ HNRAs catalysts from 1st to 200th cycle.
Table S 1. Mass activity comparisons of Ni@Pt@Ni@Pt NTAs with other Pt-based electrocatalysts.

<table>
<thead>
<tr>
<th>Electrocatayst</th>
<th>Mass current density (mA/g)</th>
<th>Testing solution</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pt-MoO$_3$-RGO NTAs</td>
<td>809.5</td>
<td>0.5 M H$_2$SO$_4$ + 0.5 M CH$_3$OH</td>
<td>This work</td>
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<tr>
<td>Pt$_{0.75}$(RuO$_2$-MoO$<em>3$)$</em>{0.25}$/C</td>
<td>31</td>
<td>0.5 M H$_2$SO$_4$ + 0.5 M CH$_3$OH</td>
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<td>Pt–MoOx(10%)-MWCNT</td>
<td>46.58</td>
<td>0.5 M H$_2$SO$_4$ + 0.5 M CH$_3$OH</td>
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<td>Pt-MoOx/CNTs</td>
<td>250</td>
<td>0.5 M H$_2$SO$_4$ + 1.0 M CH$_3$OH</td>
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<td>PtRu(7:3)/MWCNTs</td>
<td>115</td>
<td>0.5 M H$_2$SO$_4$ + 1.0 M CH$_3$OH</td>
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<td>Hollow mesoporous Pt–Ni nanospheres</td>
<td>380</td>
<td>0.5 M H$_2$SO$_4$ + 0.5 M CH$_3$OH</td>
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<td>PVP-Modified Graphite Carbon Nanofibers/PtRu</td>
<td>234</td>
<td>1.0 M H$_2$SO$_4$ + 0.5 M CH$_4$OH</td>
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<td>PtPd/RGO</td>
<td>198</td>
<td>0.1 M HClO$_4$ + 1.0 M CH$_3$OH</td>
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<td>PtRu/graphene</td>
<td>339.2</td>
<td>0.5 M H$_2$SO$_4$ + 1.0 M CH$_3$OH</td>
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<td>Pt hollow nanocrystal /graphene</td>
<td>218</td>
<td>0.5 M H$_2$SO$_4$ + 0.5 M CH$_3$OH</td>
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<td>PtRu/MC</td>
<td>19.8</td>
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<td>PtRu/graphene</td>
<td>205.7</td>
<td>0.5 M H$_2$SO$_4$ + 1.0 M CH$_3$OH</td>
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<td>Pt/MC/graphene</td>
<td>81.6</td>
<td>0.5 M H$_2$SO$_4$ + 0.5 M CH$_3$OH</td>
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<td>Pt/N-doped C</td>
<td>103</td>
<td>0.5 M H$_2$SO$_4$ + 1.0 M CH$_3$OH</td>
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<td>Pt/Sn-modified CNT</td>
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<td>Pt/TiO$_2$/C</td>
<td>102.8</td>
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<td>PtRu/HPAs-CS/graphene</td>
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<td>Pt MTNN</td>
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<td>FePtPd Nanowires</td>
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<td>0.1 M HClO$_4$ + 0.2 M CH$_3$OH</td>
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<td>Pt-on-Pd Bimetallic Nanodendrites</td>
<td>490</td>
<td>0.5 M H$_2$SO$_4$ + 1.0 M CH$_3$OH</td>
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<td>Ni@Pt@Ni@Pt NTAs</td>
<td>362.7</td>
<td>0.5 M H$_2$SO$_4$ + 0.5 M CH$_3$OH</td>
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Reference


