Supporting Information

Three-Dimensional Porous Platinum-Tellurium-Rhodium Surface/Interface Achieve Remarkable Operating Fuel Cell Catalysis

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Figure S1. (a-c) HAADF-STEM images, (d) diameter distribution, (e) length distribution, and (f) SEM-EDS of Pt₃Te₃Rh₂ NRs.
Figure S2. (a) TEM image, (b) PXRD pattern, (c) crystal structure, (d) enlarged TEM image and (e) corresponding rainbow-colored TEM image, (f) HRTEM image and related FFT pattern, (g) HAADF-STEM image and (h) corresponding line-scans, (i) HAADF-STEM image and (j) corresponding rainbow-colored HAADF-STEM image, and (k) HAADF-STEM-EDS elemental mappings of Pt$_3$Te$_3$Rh$_2$ NRs. The equalized rainbow colors ranging from red (high) to green (low) in (e) and the equalized rainbow colors ranging from blue (high) to yellow (low) in (j) obviously display the thickness difference of Pt$_3$Te$_3$Rh$_2$ NRs. The white and yellow dotted lines in (f) clearly reveal the presence of uneven surface and partially amorphized area for Pt$_3$Te$_3$Rh$_2$ NRs, respectively.
Figure S3. TEM images of (a) Pt$_3$Te$_3$Rh$_1$ NRs and (b) Pt$_3$Te$_3$Rh$_3$ NRs. (c) SEM-EDS and (d) PXRD patterns of Pt$_3$Te$_3$Rh$_1$ NRs and Pt$_3$Te$_3$Rh$_3$ NRs.
Figure S4. (a-c) HAADF-STEM images, (d) diameter distribution, (e) length distribution, and (f) TEM-EDS of PtTe NRs.
Figure S5. (a) PXRD pattern, (b) crystal structure, (c) HRTEM image and related FFT pattern, (d) HAADF-STEM image and corresponding line-scans, and (e) HAADF-STEM-EDS elemental mappings of PtTe NRs. The white dotted lines in (c) clearly reveal the presence of irregular facet boundaries.
Figure S6. (a, b) TEM images and (c) SEM-EDS of initial Pt$_3$Te$_3$Rh$_2$ NRs/C. (d, e) TEM images and (f) SEM-EDS of Pt$_3$Te$_3$Rh$_2$ NRs/C after HAc washing. (g, h) TEM images and (i) SEM-EDS of Pt$_3$Te$_3$Rh$_2$ NRs/C after HAc washing and further annealing at 200 °C in air atmosphere for 1 h.
Figure S7. HAADF-STEM image of porous Pt$_{61}$Te$_8$Rh$_{31}$ NRs/C.

Figure S8. (a) TEM image and (b) SEM-EDS of porous Pt$_{69}$Te$_7$Rh$_{24}$ NRs/C. (c) TEM image and (d) SEM-EDS of porous Pt$_{62}$Te$_{15}$Rh$_{23}$ NRs/C.
Figure S9. (a, b) TEM images and (c) SEM-EDS of initial PtTe NRs/C. (d, e) TEM images and (f) SEM-EDS of PtTe NRs/C after HAc washing. (g, h) TEM images and (i) SEM-EDS of PtTe NRs/C after HAc washing and further annealing at 200 °C in air atmosphere for 1 h.
Figure S10. (a, b) TEM images and (c) SEM-EDS of PtTe NRs/C after HAc washing and further annealing at 200 °C in air atmosphere for 1 h and then electrochemical sweeping in 0.1 M HClO$_4$ solution for 1000 CV cycles (i.e. porous Pt$_{95}$Te$_5$ NRs/C). (d, e) TEM images and (f) SEM-EDS of porous Pt$_{95}$Te$_5$ NRs/C after 30000 potential cycles between 0.6 V and 1.1 V vs. RHE.
Figure S11. TEM images of commercial Pt/C (a, b) before and (c, d) after 30000 potential cycles between 0.6 and 1.1 V vs. RHE.

Figure S12. CVs of different catalysts in 0.1 M HClO$_4$ solutions. The colored symbols of ①, ②, ③, ④, and ⑤ represent commercial Pt/C, porous Pt$_{95}$Te$_5$ NRs/C, porous Pt$_{69}$Te$_7$Rh$_{24}$ NRs/C, porous Pt$_{61}$Te$_8$Rh$_{31}$ NRs/C, and porous Pt$_{62}$Te$_{15}$Rh$_{23}$ NRs/C, respectively.
Figure S13. (a) CVs and (b) ORR polarization curves of commercial Pt/C before and after different potential cycles between 0.6 and 1.1 V vs. RHE. (c) CVs and (d) ORR polarization curves of porous Pt$_{95}$Te$_5$ NRs/C before and after different potential cycles between 0.6 and 1.1 V vs. RHE. (e) CVs of porous Pt$_{61}$Te$_8$Rh$_{31}$ NRs/C before and after different potential cycles between 0.6 and 1.1 V vs. RHE.
Figure S14. (a) CVs and (b) ORR polarization curves of porous Pt$_{69}$Te$_7$Rh$_{24}$ NRs/C before and after different potential cycles between 0.6 and 1.1 V vs. RHE. (c) CVs and (d) ORR polarization curves of porous Pt$_{62}$Te$_{15}$Rh$_{23}$ NRs/C before and after different potential cycles between 0.6 and 1.1 V vs. RHE.
Figure S15. (a, b) HAADF-STEM images, (c) TEM-EDS, (d) TEM image, and (e, f) HRTEM images of porous Pt$_{61}$Te$_8$Rh$_{31}$ NRs/C after 30000 potential cycles between 0.6 and 1.1 V vs. RHE. The white and yellow dotted lines in (e, f) clearly reveal the presence of irregular facet boundaries and partially amorphized areas, respectively, further demonstrating the structure stability of porous Pt$_{61}$Te$_8$Rh$_{31}$ NRs/C in ORR medium. (g) Energy survey, (h) Pt 4f, (i) Te 3d, and (j) Rh 3d XPS spectra of porous Pt$_{61}$Te$_8$Rh$_{31}$ NRs/C after 30000 potential cycles between 0.6 and 1.1 V vs. RHE. The surface molar ratio of Pt/Te/Rh was 80.4/5.9/13.7 for porous Pt$_{61}$Te$_8$Rh$_{31}$ NRs/C after 30000 potential cycles between 0.6 and 1.1 V vs. RHE, as determined by the XPS.
Figure S16. PEMFC polarization curves and power density curves of different cathodic catalysts in (a) H₂/air and (b) H₂/O₂ media at 150 kPa BP. (c) Histogram of maximum power densities for different catalysts in H₂/air and H₂/O₂ media at 150 kPa BP. The colored symbols of ① and ④ represent commercial Pt/C and porous Pt₆₁Te₈Rh₃₁ NRs/C, respectively.
Figure S17. PEMFC polarization curves and power density curves of porous Pt$_{61}$Te$_8$Rh$_{31}$ NRs/C in (a) H$_2$/air and (c) H$_2$/O$_2$ media at 50/100/150 kPa BP. Histogram of maximum power densities for porous Pt$_{61}$Te$_8$Rh$_{31}$ NRs/C in (b) H$_2$/air and (d) H$_2$/O$_2$ media at 50/100/150 kPa BP.
Figure S18. (a) The AST and (b) enlarged initial 60 s AST characterizations by square wave between 0.6 and 0.95 V at 3 s at each potential for 30000 cycles. The time-dependent current density curves of (c) commercial Pt/C and (d) porous Pt$_{61}$Te$_3$Rh$_{31}$ NRs/C during the AST for 30000 cycles. The AST was run at 200/200 mL min$^{-1}$ H$_2$/N$_2$, 80/80 °C, 100/100% RH and 100/100 kPa BP in the order of anode/cathode.
Figure S19. PEMFC polarization curves and power density curves of different cathodic catalysts before and after 30000 cycles at 100/150 kPa BP in (a, c) H$_2$/air and (b, d) H$_2$/O$_2$ media. The colored symbols of ① and ④ represent commercial Pt/C and porous Pt$_{61}$Te$_8$Rh$_{31}$ NRs/C, respectively.
Figure S20. (a) Energy survey, (b) Pt 4f, (c) Te 3d, and (d) Rh 3d XPS spectra of initial Pt₃Te₃Rh₂ NRs/C. The surface molar ratio of Pt/Te/Rh was 36.2/36.1/27.7 for initial Pt₃Te₃Rh₂ NRs/C, as determined by the XPS.

Figure S21. (a) Pt L₃-edge XANES profiles of Pt foil, PtTe NRs/C, and PtTeRh NRs/C with different compositions. The inset in (a) is the magnified near-edge structures of different catalysts. (b) Pt L₃-edge EXAFS spectra in R space for Pt foil, PtTe NRs/C, and PtTeRh NRs/C with different compositions. The dotted lines indicate the experiment data, and the solid lines represent the simulation data.
Figure S22. Rh K-edge EXAFS spectra in R space for Rh foil, Rh$_2$O$_3$ powder, and PtTeRh NRs/C with different compositions. The dotted lines indicate the experiment data, and the solid lines represent the simulation data.

Figure S23. Wavelet transform analyses of the Pt L$_3$-edge EXAFS data for (a) Pt foil, (b) PtO$_2$, (c) PtTe NRs/C, (d) Pt$_3$Te$_3$Rh$_1$ NRs/C, (e) Pt$_3$Te$_3$Rh$_2$ NRs/C, and (f) Pt$_3$Te$_3$Rh$_3$ NRs/C.
Figure S24. Wavelet transform analyses of the Rh K-edge EXAFS data for (a) Rh foil, (b) Rh$_2$O$_3$ powder, (c) Pt$_3$Te$_3$Rh$_2$ NRs/C, and (f) porous Pt$_{61}$Te$_9$Rh$_{31}$ NRs/C.

Figure S25. Calibration of SCE and conversion to RHE. The reference electrode calibration of SCE was performed in a standard three-electrode system with polished Pt plates (1 × 1 cm$^2$) as the working and counter electrodes, and the SCE as the reference electrode. The electrolyte was pre-purged and saturated with high purity H$_2$. Linear scanning voltammetry (LSV) was then run at a scan rate of 0.1 mV s$^{-1}$, and the potential at which the current crossed zero was taken to be the thermodynamic potential (vs. SCE) for the hydrogen electrode reaction. In the 0.1 M HClO$_4$ solution, the zero current point was at -0.309 V vs. SCE, so $E$ (RHE) = $E$ (SCE) + 0.309 V.
Table S1. ECSAs and ORR activities of different catalysts at 0.90 V vs. RHE. ORR measurements were performed at room temperature in O₂-saturated HClO₄ solution at a sweep rate of 10 mV s⁻¹ and a rotation rate of 1600 rpm. The activities were calculated based on several parallel measurements after Ohmic drop correction.

<table>
<thead>
<tr>
<th>Catalyst</th>
<th>Loading of metal Pt (μg)</th>
<th>ECSA (m² g⁻¹)</th>
<th>Mass activity at RT (A mg⁻¹Pt)</th>
<th>Specific activity at RT (mA cm⁻²)</th>
</tr>
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<tbody>
<tr>
<td>commercial Pt/C</td>
<td>2.0</td>
<td>68.9</td>
<td>0.17</td>
<td>0.25</td>
</tr>
<tr>
<td>porous Pt₆₃Te₅ NRs/C</td>
<td>2.0</td>
<td>52.7</td>
<td>1.41</td>
<td>2.68</td>
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<tr>
<td>porous Pt₆₉Te₇Rh₂₄ NRs/C</td>
<td>2.0</td>
<td>53.5</td>
<td>2.05</td>
<td>3.83</td>
</tr>
<tr>
<td>porous Pt₆₃Te₇Rh₁₁ NRs/C</td>
<td>2.0</td>
<td>54.3</td>
<td>2.40</td>
<td>4.42</td>
</tr>
<tr>
<td>porous Pt₆₅Te₁₇Rh₂₃ NRs/C</td>
<td>2.0</td>
<td>54.1</td>
<td>0.42</td>
<td>0.78</td>
</tr>
</tbody>
</table>
Table S2. Acidic ORR activities of porous Pt$_{61}$Te$_8$Rh$_{31}$ NRs/C and state-of-the-art Pt-based nanocatalysts from recent 5 years-published works at 0.90 V/0.95 V vs. RHE. The ORR measurements were performed at room temperature in O$_2$-saturated HClO$_4$ solution at a sweep rate of 10 mV s$^{-1}$ and a rotation rate of 1600 rpm.

<table>
<thead>
<tr>
<th>Catalyst</th>
<th>$J_m$ (A mg$^{-1}$Pt)</th>
<th>$J_s$ (mA cm$^{-2}$)</th>
<th>Ref.</th>
</tr>
</thead>
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<tr>
<td><strong>Porous Pt$_{61}$Te$<em>8$Rh$</em>{31}$ NRs/C</strong></td>
<td>2.40/1.22 @ 0.90 V/0.95 V vs. RHE</td>
<td>4.42/2.24 @ 0.90 V/0.95 V vs. RHE</td>
<td>This Work</td>
</tr>
<tr>
<td>Porous Pt$_{61}$Te$<em>8$Rh$</em>{31}$ NRs/C-ADT</td>
<td>2.22/0.59 @ 0.90 V/0.95 V vs. RHE</td>
<td>3.99/1.06 @ 0.90 V/0.95 V vs. RHE</td>
<td>This Work</td>
</tr>
<tr>
<td>PtCuBiBm Nanosheets/C</td>
<td>0.69</td>
<td>2.41</td>
<td><strong>Adv. Mater. 2017, 29, 1604994</strong></td>
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<tr>
<td>Pt Nanowires/C</td>
<td>0.71</td>
<td>2.20</td>
<td><strong>Adv. Mater. 2017, 29, 1703460</strong></td>
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<tr>
<td>Pt$_{13}$Ni Nanowires/C</td>
<td>1.52</td>
<td>3.58</td>
<td><strong>Adv. Mater. 2017, 29, 1703460</strong></td>
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<td>Rh-Doped Pt Nanowires/C</td>
<td>1.41</td>
<td>1.63</td>
<td><strong>J. Am. Chem. Soc. 2017, 139, 8152</strong></td>
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<td>PtPb$<em>{1.12}$Ni$</em>{0.14}$ Octahedra/C</td>
<td>1.92</td>
<td>5.16</td>
<td><strong>J. Am. Chem. Soc. 2017, 139, 9576</strong></td>
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<td>PtCo@HGS</td>
<td>0.97</td>
<td>0.92</td>
<td><strong>Adv. Energy Mater. 2017, 7, 1700835</strong></td>
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<td>Pt-Ni Nanocage/C</td>
<td>0.50</td>
<td>0.70</td>
<td><strong>Appl. Catal. B: Environ. 2017, 203, 927</strong></td>
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<td>PtCuPd Cubic Nanoskeletons/C</td>
<td>1.04</td>
<td>2.41</td>
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<td>PtCo Excavated Octahedra/C</td>
<td>~ 0.35</td>
<td>1.85</td>
<td><strong>Nano Energy 2017, 39, 582</strong></td>
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<td>Pt$_2$Co Excavated Octahedra/C</td>
<td>~ 0.32</td>
<td>2.41</td>
<td><strong>Nano Energy 2017, 39, 582</strong></td>
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<td>PtCu Dendrites@PtCuNi Frames/C</td>
<td>2.48</td>
<td>7.34</td>
<td><strong>ACS Nano 2017, 11, 10844</strong></td>
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<td>Porous PtAgBiCo Nanoplates/C</td>
<td>0.81</td>
<td>1.95</td>
<td><strong>Chem. Sci. 2017, 8, 4292</strong></td>
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<td>PtNi Nanoporous Nanowires/C</td>
<td>0.33</td>
<td>0.99</td>
<td><strong>J. Mater. Chem. A 2017, 5, 23651</strong></td>
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<td>RD-CuPt Nanoframes/C</td>
<td>0.92</td>
<td>1.70</td>
<td><strong>Chem. Mater. 2017, 29, 5681</strong></td>
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<td>Spiny RD-CuPt Nanoframes/C</td>
<td>0.86</td>
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<td><strong>Electrochim. Acta 2017, 246, 242</strong></td>
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<tr>
<td>B-Doped Pt$_{3}$Ni Nanoparticles/C</td>
<td>0.60</td>
<td>1.35</td>
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<tr>
<td>Pt$_{13}$Ni Nanoparticles/C</td>
<td>0.35</td>
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<td>Pt Nanoparticles/C</td>
<td>0.20</td>
<td>0.23</td>
<td><strong>ACS Appl. Mater. Interfaces 2017, 9, 31806</strong></td>
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<td>L1$<em>2$-Pt$</em>{3}$Fe Nanoparticles/C</td>
<td>0.45</td>
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<td><strong>ACS Appl. Mater. Interfaces 2017, 9, 36164</strong></td>
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<td>Pt-Fe Nanoparticles/C</td>
<td>0.19</td>
<td>0.51</td>
<td><strong>ACS Appl. Mater. Interfaces 2017, 9, 36164</strong></td>
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<td>PtCo Concave Nanocubes/C</td>
<td>0.24</td>
<td>0.44</td>
<td><strong>Science 2018, 362, 1276</strong></td>
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<td>PtCo+Co@Graphene+Co-N$_2$-C$_y$</td>
<td>8.64/2.68</td>
<td>7.86/2.44</td>
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<td>Pt$_3$Co+Co@Graphene+Co/Zn-N$_2$-C$_y$</td>
<td>12.36/3.95</td>
<td>10.66/3.41</td>
<td><strong>Science 2018, 362, 1276</strong></td>
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<td>Pt$_3$Co/ZC</td>
<td>2.98/0.91</td>
<td>NA</td>
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<td>Pt$<em>3$Fe$</em>{3}$-FePt/Pt Nanoparticles/C</td>
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<td>Pt Nanowires/C</td>
<td>0.88</td>
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<td>Pt$_{3}$Ni Nanowires/C</td>
<td>2.10</td>
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<td><strong>J. Am. Chem. Soc. 2018, 140, 16159</strong></td>
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<td>Pt$<em>3$NiRh$</em>{0.28}$ Nanowires/C</td>
<td>2.88</td>
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<td>Pt-Skin PtFe z-Nanowires/C</td>
<td>2.11</td>
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<td>2.69</td>
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<td>Ga-Doped PtNi Octahedra/C</td>
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<td>Ultrathin Pt Nanoplates/C</td>
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<td>PtNi(Pt-skin)/Pd20 Nanoparticles/C</td>
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<td>14.20</td>
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<td>PtCo/Co@NiHPCc</td>
<td>0.57</td>
<td>NA</td>
<td>Appl. Catal. B. 2018, 225, 496</td>
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<td>Pt-o-Cu/pt Nanoparticles/C</td>
<td>0.64</td>
<td>1.73</td>
<td>ACS Appl. Mater. Interfaces 2018, 10, 38015</td>
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<td>Pt-d-Cu/pt Nanoparticles/C</td>
<td>0.57</td>
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<td>Rhombic Dodecahedral PtCuNi Nanoskeletons/C</td>
<td>0.86</td>
<td>1.65</td>
<td>J. Power Sources 2018, 406, 42</td>
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<td>PtCu Dodecahedral Nanoskeletons/C</td>
<td>0.79</td>
<td>2.03</td>
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<td>Pt-Ni Bunched Nanocages/C</td>
<td>3.52</td>
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<td>Science 2019, 366, 850</td>
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<td>Pt-Ni Bunched Nanospheres/C</td>
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<td>Pt Nanowires/C</td>
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<td>2.20</td>
<td>Joule 2019, 3, 124</td>
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<td>2.26</td>
<td>8.26</td>
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<td>Etched A1-CoPt Nanoparticles/C</td>
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<td>SnO2/Pt-Cu-Ni (5) Nanoparticles/C</td>
<td>NA</td>
<td>1.60</td>
<td>J. Am. Chem. Soc. 2019, 141, 9463</td>
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<td>C-L10-PtNi0.5Co0.5 Nanoparticles</td>
<td>2.28</td>
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<td>Adv. Energy Mater. 2019, 9, 1803771</td>
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<td>H-PtCo@Pt1N-C</td>
<td>1.20</td>
<td>2.39</td>
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<td>Ordered PtCo3 H600</td>
<td>0.72</td>
<td>NA</td>
<td>Adv. Funct. Mater. 2019, 29, 1902987</td>
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<td>L10-W-PtCo Nanoparticles/C</td>
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<td>3.60</td>
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<td>L10PtCo Nanoparticles/C</td>
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<td>3.43</td>
<td>5.76</td>
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<td>4.6%Pd-Doped Pt Nanoplates/C</td>
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<td>Pt/Se Nanoparticles/C</td>
<td>0.75</td>
<td>0.32</td>
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<td>Pt3In2Ni1.8 Nanoparticles/C</td>
<td>0.76</td>
<td>1.96</td>
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<td>Pt3In1Ni Nanoparticles/C</td>
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<td>5 nm-Pt Nanoparticles/C</td>
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<td>Pd@PtNi Nanowires/C</td>
<td>1.75</td>
<td>3.18</td>
<td></td>
</tr>
<tr>
<td>PdPtNi Nanoparticles/C</td>
<td>0.71</td>
<td>1.25</td>
<td></td>
</tr>
<tr>
<td>PtNi Nanoparticles@C-2 Composites</td>
<td>0.84</td>
<td>1.54</td>
<td>ACS Appl. Energy Mater. 2019, 2, 2769</td>
</tr>
<tr>
<td>Pt3Co Nanoparticles/C</td>
<td>~ 1.13</td>
<td>~ 2.25</td>
<td>ACS Appl. Mater. Interfaces 2019, 11, 26789</td>
</tr>
<tr>
<td>Pt57Fe33 Nanoparticles/C</td>
<td>0.17</td>
<td>0.25</td>
<td>ACS Sustainable Chem. Eng. 2019, 7, 6541</td>
</tr>
<tr>
<td>Pt57Co33 Nanoparticles/C</td>
<td>0.18</td>
<td>0.26</td>
<td></td>
</tr>
<tr>
<td>Pt57Ni33 Nanoparticles/C</td>
<td>0.28</td>
<td>0.37</td>
<td></td>
</tr>
<tr>
<td>Pt57Ni22 Rough Nanowires/C</td>
<td>1.07</td>
<td>1.02</td>
<td>Nano Res. 2019, 12, 1721</td>
</tr>
<tr>
<td>Pt Rough Nanowires/C</td>
<td>0.67</td>
<td>0.62</td>
<td></td>
</tr>
<tr>
<td>37 wt%-FePt Nanoparticles/rGO</td>
<td>1.96</td>
<td>NA</td>
<td>J. Am. Chem. Soc. 2020, 142, 14190</td>
</tr>
<tr>
<td>V2O5-PtCu Nanowire Networks</td>
<td>3.15</td>
<td>4.97</td>
<td>Angew. Chem. Int. Ed. 2020, 59, 13778</td>
</tr>
<tr>
<td>L10PtZn Nanoparticles/C</td>
<td>1.02</td>
<td>1.68</td>
<td>Adv. Energy Mater. 2020, 10, 2000179</td>
</tr>
<tr>
<td>Pt-Co Concave Nanocubes@C</td>
<td>0.26</td>
<td>2.34</td>
<td>ACS Appl. Energy Mater. 2020, 3, 5077</td>
</tr>
<tr>
<td>Ordered PtCu Nanoskeletons/C</td>
<td>2.47</td>
<td>4.69</td>
<td>Nano Lett. 2020, 20, 7413</td>
</tr>
<tr>
<td>Sample Description</td>
<td>α</td>
<td>β</td>
<td></td>
</tr>
<tr>
<td>------------------------------------------</td>
<td>-----</td>
<td>-----</td>
<td></td>
</tr>
<tr>
<td>PtNi Nanoparticles/C</td>
<td>0.52</td>
<td>0.82</td>
<td></td>
</tr>
<tr>
<td>Hollow PtNi Nanoparticles/C</td>
<td>0.75</td>
<td>1.16</td>
<td></td>
</tr>
<tr>
<td>Hollow PtNi Nanoparticles/C</td>
<td>0.85</td>
<td>1.49</td>
<td></td>
</tr>
<tr>
<td>Hollow PtNi Nanoparticles/C</td>
<td>0.62</td>
<td>1.19</td>
<td></td>
</tr>
<tr>
<td>PtNi/Pd/WSi Nanoparticles/C</td>
<td>2.96</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>PtNi/Pd/WSi Nanoparticles/C</td>
<td>2.53</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>Dealloyed 5.1 nm PtCo3 Nanoparticles/C</td>
<td>NA</td>
<td>1.51</td>
<td></td>
</tr>
<tr>
<td>Int-PtNi Nanoparticles/KB</td>
<td>1.83</td>
<td>2.92</td>
<td></td>
</tr>
<tr>
<td>D-PtNi Nanoparticles/KB</td>
<td>0.58</td>
<td>1.25</td>
<td></td>
</tr>
<tr>
<td>D-PtNi Nanoparticles/KB</td>
<td>0.46</td>
<td>1.10</td>
<td></td>
</tr>
<tr>
<td>46.4% Commercial Pt/C TKK</td>
<td>0.18</td>
<td>0.38</td>
<td></td>
</tr>
<tr>
<td>Pd@Pt Nanoparticles/C-As-Synthesized</td>
<td>0.99/0.10</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>Pd@Pt Nanoparticles/C-As-Synthesized + Melamine</td>
<td>1.95/0.37</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>Pd@Pt Nanoparticles/C-After HAP</td>
<td>1.46/0.14</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>Pd@Pt Nanoparticles/C-After HAP + Melamine</td>
<td>3.63/0.54</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>Highly Distorted Pt Nanorods/C</td>
<td>2.77</td>
<td>4.70</td>
<td></td>
</tr>
<tr>
<td>Weakly Distorted Pt Nanorods/C</td>
<td>0.49</td>
<td>1.02</td>
<td></td>
</tr>
<tr>
<td>20% Commercial Pt/C JM</td>
<td>0.17</td>
<td>0.25</td>
<td></td>
</tr>
<tr>
<td>Pt/Pt2 Nanoparticles/NPC</td>
<td>0.72</td>
<td>0.51</td>
<td></td>
</tr>
<tr>
<td>Pt2 Nanoparticles/NPC</td>
<td>0.47</td>
<td>0.44</td>
<td></td>
</tr>
<tr>
<td>Pt Nanoparticles/NPC</td>
<td>0.15</td>
<td>0.18</td>
<td></td>
</tr>
<tr>
<td>PtCo ERD Nanocrystals/C</td>
<td>0.94</td>
<td>2.68</td>
<td></td>
</tr>
<tr>
<td>PtCo RD Nanocrystals/C</td>
<td>0.54</td>
<td>1.43</td>
<td></td>
</tr>
<tr>
<td>N-Doped Pt Nanoparticles/C</td>
<td>0.102</td>
<td>0.148</td>
<td></td>
</tr>
<tr>
<td>N-Doped Pt Nanoparticles/C-H2</td>
<td>0.096</td>
<td>0.146</td>
<td></td>
</tr>
<tr>
<td>60% Commercial Pt/C JM</td>
<td>0.095</td>
<td>0.132</td>
<td></td>
</tr>
<tr>
<td>Pt Nanoparticles/p-BN</td>
<td>1.06</td>
<td>1.24</td>
<td></td>
</tr>
<tr>
<td>20% Commercial Pt/C HPT020</td>
<td>0.17</td>
<td>0.27</td>
<td></td>
</tr>
<tr>
<td>PtFe/Pt-i-Nanoparticles/C</td>
<td>~ 2.20</td>
<td>~ 1.80</td>
<td></td>
</tr>
<tr>
<td>PtCo/Pt-i-Nanoparticles/C</td>
<td>~ 2.50</td>
<td>~ 2.75</td>
<td></td>
</tr>
<tr>
<td>PtNi/Pt-i-Nanoparticles/C</td>
<td>~ 2.40</td>
<td>~ 3.30</td>
<td></td>
</tr>
<tr>
<td>PtCu/Pt-i-Nanoparticles/C</td>
<td>4.18</td>
<td>3.80</td>
<td></td>
</tr>
<tr>
<td>PtZn/Pt-i-Nanoparticles/C</td>
<td>~ 1.90</td>
<td>~ 1.20</td>
<td></td>
</tr>
<tr>
<td>Pt-CoO 1 Network</td>
<td>4.60</td>
<td>4.57/0.52</td>
<td></td>
</tr>
<tr>
<td>Pt-CoO 2 Network</td>
<td>5.19</td>
<td>4.52/0.51</td>
<td></td>
</tr>
<tr>
<td>Pt-CoO 3 Network</td>
<td>5.74</td>
<td>3.77/0.49</td>
<td></td>
</tr>
<tr>
<td>Pt-CoO Heat 1 Network</td>
<td>6.75</td>
<td>4.59/0.59</td>
<td></td>
</tr>
<tr>
<td>Pt-CoO Heat 2 Network</td>
<td>8.37</td>
<td>5.38/0.62</td>
<td></td>
</tr>
<tr>
<td>L12-PtCo Nanoparticles/Fe2N2-C</td>
<td>1.34</td>
<td>3.98</td>
<td></td>
</tr>
<tr>
<td>Pt Nanoparticles/Fe2N2-C</td>
<td>0.57</td>
<td>0.79</td>
<td></td>
</tr>
<tr>
<td>Commercial Pt/C TKK-TEC10V20E</td>
<td>0.24</td>
<td>0.44</td>
<td></td>
</tr>
<tr>
<td>PdPt Tesseracts/C</td>
<td>1.86</td>
<td>2.09</td>
<td></td>
</tr>
<tr>
<td>Coplanar Pt/C NMs</td>
<td>1.01</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>H-Pt Superstructures/C</td>
<td>2.24</td>
<td>4.52</td>
<td></td>
</tr>
<tr>
<td>M-Pt Superstructures/C</td>
<td>1.92</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>Material Type</td>
<td>Mass Activity (J_m)</td>
<td>Specific Activity (J_s)</td>
<td>Journal Reference</td>
</tr>
<tr>
<td>---------------</td>
<td>---------------------</td>
<td>-------------------------</td>
<td>------------------</td>
</tr>
<tr>
<td>Pt@Co Octahedra/C</td>
<td>1.07</td>
<td>2.16</td>
<td>Nano Lett. 2021, 21, 6625</td>
</tr>
<tr>
<td>PtCo Octahedra/C</td>
<td>1.05</td>
<td>2.32</td>
<td>Nano Lett. 2021, 21, 9354</td>
</tr>
<tr>
<td>20% Commercial Pt/C JM</td>
<td>0.14</td>
<td>0.21</td>
<td>ACS Catal. 2021, 11, 355</td>
</tr>
<tr>
<td>1.1 nm-Pt Nanowires/C</td>
<td>1.00</td>
<td>1.20</td>
<td>ACS Catal. 2021, 11, 466</td>
</tr>
<tr>
<td>1.5 nm-Pt Nanowires/C</td>
<td>0.77</td>
<td>0.95</td>
<td>ACS Catal. 2021, 11, 9355</td>
</tr>
<tr>
<td>2.4 nm-Pt Nanowires/C</td>
<td>0.51</td>
<td>0.68</td>
<td>Nano Energy 2021, 88, 106221</td>
</tr>
<tr>
<td>PtPtN1 Nanoparticles/C</td>
<td>4.40</td>
<td>9.08</td>
<td>Angew. Chem. Int. Ed. 2022, 61, e202115835</td>
</tr>
<tr>
<td>PtN1-Pt Nanoparticles/C</td>
<td>1.00</td>
<td>1.81</td>
<td>J. Mater. Chem. A 2021, 9, 23444</td>
</tr>
<tr>
<td>20% Commercial Pt/C JM</td>
<td>0.14</td>
<td>0.20</td>
<td>Energy Environ. Sci. 2021, 15, 1892</td>
</tr>
<tr>
<td>PtPtN1 Nanoparticles@NCNTs</td>
<td>3.46</td>
<td>4.61</td>
<td>Adv. Sci. 2022, 9, 2104927</td>
</tr>
<tr>
<td>h-PtNiCo Branched Nanocages/C</td>
<td>1.03</td>
<td>2.75</td>
<td>Adv. Sci. 2022, 9, 2200147</td>
</tr>
<tr>
<td>h-PtNi Branched Nanocages/C</td>
<td>0.37</td>
<td>1.39</td>
<td>Chem. Eng. J. 2022, 428, 131569</td>
</tr>
<tr>
<td>PtCo@Pt Nanoparticles/C</td>
<td>0.71</td>
<td>2.75</td>
<td>Angew. Chem. Int. Ed. 2022, 61, e202115835</td>
</tr>
<tr>
<td>PtCo Nanoparticles@NGNS</td>
<td>1.29</td>
<td>1.70</td>
<td>Angew. Chem. Int. Ed. 2022, 61, e202115835</td>
</tr>
<tr>
<td>20% Commercial Pt/C</td>
<td>0.15</td>
<td>0.20</td>
<td>Angew. Chem. Int. Ed. 2022, 61, e202115835</td>
</tr>
<tr>
<td>PtCu Nested Skeleton Cubes/C</td>
<td>3.86</td>
<td>7.40</td>
<td>Angew. Chem. Int. Ed. 2022, 61, e202115835</td>
</tr>
<tr>
<td>PtCu A-Nested Skeleton Cubes/C</td>
<td>5.13</td>
<td>7.20</td>
<td>Angew. Chem. Int. Ed. 2022, 61, e202115835</td>
</tr>
<tr>
<td>PtCu Octahedral Stars/C</td>
<td>0.59</td>
<td>1.70</td>
<td>Angew. Chem. Int. Ed. 2022, 61, e202115835</td>
</tr>
<tr>
<td>PtCu A-Octahedral Stars/C</td>
<td>1.02</td>
<td>2.14</td>
<td>Angew. Chem. Int. Ed. 2022, 61, e202115835</td>
</tr>
<tr>
<td>Pt-Skin Pt0.3Zn0.2 Nanocubes/KB</td>
<td>1.18</td>
<td>3.64</td>
<td>Angew. Chem. Int. Ed. 2022, 61, e202115835</td>
</tr>
<tr>
<td>Pd@Pt0.4 Nanoparticles/C</td>
<td>0.58</td>
<td>0.71</td>
<td>Chem. Eng. J. 2022, 428, 131569</td>
</tr>
<tr>
<td>PtFe (0.9) Nanoparticles/C</td>
<td>0.69</td>
<td>0.71</td>
<td>Chem. Eng. J. 2022, 428, 131569</td>
</tr>
<tr>
<td>PtFe (5) Nanoparticles/C</td>
<td>0.21</td>
<td>0.88</td>
<td>Chem. Eng. J. 2022, 428, 131569</td>
</tr>
<tr>
<td>20% Commercial Pt/C JM</td>
<td>0.30</td>
<td>0.26</td>
<td>Chem. Eng. J. 2022, 428, 131569</td>
</tr>
</tbody>
</table>

*J_m*: Mass Activity  *J_s*: Specific Activity  NA: not available
Table S3. Peak power density and lifetime of porous Pt$_{61}$Te$_8$Rh$_{31}$ NRs/C and commercial Pt/C for MEA catalysis under the self-breathing H$_2$-air fuel cell conditions.

<table>
<thead>
<tr>
<th>Catalyst</th>
<th>Loading of metal Pt (mg Pt cm$^{-2}$)</th>
<th>Peak power density (W g$^{-1}$Pt)</th>
<th>Lifetime Peak power density loss</th>
</tr>
</thead>
<tbody>
<tr>
<td>commercial Pt/C</td>
<td>0.30</td>
<td>446.7</td>
<td>after 205 h, 89.6% loss</td>
</tr>
<tr>
<td>porous Pt$_{61}$Te$<em>8$Rh$</em>{31}$ NRs/C</td>
<td>0.17</td>
<td>1023.8</td>
<td>after 240 h, 35.7% loss</td>
</tr>
</tbody>
</table>

Table S4. MEA performances of porous Pt$_{61}$Te$_8$Rh$_{31}$ NRs/C and state-of-the-art Pt-based nanocatalysts as the cathodic catalysts from other published works in self-breathing PEMFC medium (room temperature and atmospheric pressure).

<table>
<thead>
<tr>
<th>Catalyst (Anode Side I Cathode Side)</th>
<th>Peak Power Density (mW cm$^{-2}$)</th>
<th>Open Circuit Voltage in single cell (V)</th>
<th>Anodic/Cathodic Pt Loading Amounts (mg Pt cm$^{-2}$)</th>
<th>Ref.</th>
</tr>
</thead>
<tbody>
<tr>
<td>70% Commercial Pt/C (20% Nafion) I 11.2% Porous Pt$_{61}$Te$<em>8$Rh$</em>{31}$ NRs/C (40% Nafion)</td>
<td>174.05</td>
<td>0.921</td>
<td>0.50/0.17</td>
<td>This Work</td>
</tr>
<tr>
<td>70% Commercial Pt/C (20% Nafion) I 20% Commercial Pt/C (40% Nafion)</td>
<td>134.00</td>
<td>0.917</td>
<td>0.50/0.30</td>
<td></td>
</tr>
<tr>
<td>30% Commercial PtRu/C I 30% Commercial Pt/C with Flexible Porous CNT Membrane</td>
<td>145.2</td>
<td>∼ 0.80</td>
<td>0.50/0.50</td>
<td>ACS Nano 2017, 11, 5982</td>
</tr>
<tr>
<td>Pt Nanoparticles/Graphene Nanosheets I 70% Pt/C with Cone-Shaped Nafion Array-1.3 μm</td>
<td>139</td>
<td>∼ 0.80</td>
<td>0.018/0.40</td>
<td>J. Mater. Chem. A 2020, 8, 5489</td>
</tr>
<tr>
<td>70% Commercial Pt/C I 70% Commercial Pt/C with New GDL/Porous CNT Membrane</td>
<td>230</td>
<td>∼ 0.95</td>
<td>0.50/0.50</td>
<td>J. Mater. Chem. A 2020, 8, 5986</td>
</tr>
<tr>
<td>70% Commercial Pt/C I 70% Commercial Pt/C with Commercial GDL/Porous CNT Membrane</td>
<td>145</td>
<td>∼ 0.79</td>
<td></td>
<td>Int. J. Hydrogen Energy 2009, 34, 7761</td>
</tr>
<tr>
<td>40% Commercial Pt/C I 40% Commercial Pt/C with Circular Cathodic Opening Design</td>
<td>∼ 275</td>
<td>∼ 0.90</td>
<td>0.40/0.40</td>
<td></td>
</tr>
<tr>
<td>40% Commercial Pt/C I 40% Commercial Pt/C with Parallel Cathodic Opening Design</td>
<td>∼ 210</td>
<td>∼ 0.90</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Si Wafer-500 μm I Pt Nanoparticles/Carbon Paper with 350 nm-sized Porous Si Surface</td>
<td>7.5</td>
<td>∼ 0.90</td>
<td>0/0.38</td>
<td>Microsyst. Technol. 2017, 23, 3257</td>
</tr>
<tr>
<td>Si Wafer-500 μm I Pt Nanoparticles/Carbon Paper with 5 μm-sized Porous Si Surface</td>
<td>5.5</td>
<td>∼ 0.97</td>
<td></td>
<td></td>
</tr>
<tr>
<td>60% Commercial Pt/C I 60% Commercial Pt/C</td>
<td>∼ 90</td>
<td>∼ 0.92</td>
<td>0.10/0.15</td>
<td>Science 2019, 366, 850</td>
</tr>
<tr>
<td>60% Commercial Pt/C I Pt$_{1.5}$Ni-BNCs/C</td>
<td>∼ 110</td>
<td>∼ 1.10</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table S5. Peak power density and lifetime of porous Pt$_{61}$Te$_8$Rh$_{31}$ NRs/C and commercial Pt/C for MEA catalysis under the operating H$_2$-air/O$_2$ fuel cell conditions.

<table>
<thead>
<tr>
<th>Catalyst</th>
<th>commercial Pt/C</th>
<th>porous Pt$_{61}$Te$<em>8$Rh$</em>{31}$ NRs/C</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Loading of metal Pt (mg Pt cm$^{-2}$)</strong></td>
<td>0.10</td>
<td>0.10</td>
</tr>
<tr>
<td><strong>Peak power density in H$_2$/air medium (mW cm$^{-2}$)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>50 kPa BP</td>
<td>/</td>
<td>682.8</td>
</tr>
<tr>
<td>100 kPa BP</td>
<td>505.6</td>
<td>727.8</td>
</tr>
<tr>
<td>150 kPa BP</td>
<td>555.4</td>
<td>743.4</td>
</tr>
<tr>
<td><strong>Peak power density in H$_2$/O$_2$ medium (mW cm$^{-2}$)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>50 kPa BP</td>
<td>/</td>
<td>1634.2</td>
</tr>
<tr>
<td>100 kPa BP</td>
<td>1017.5</td>
<td>1851.0</td>
</tr>
<tr>
<td>150 kPa BP</td>
<td>1338.8</td>
<td>1976.1</td>
</tr>
<tr>
<td><strong>Peak power density loss in H$_2$/air medium</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>150 kPa BP</td>
<td>20.1%</td>
<td>13.2%</td>
</tr>
<tr>
<td><strong>Peak power density loss in H$_2$/O$_2$ medium</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>150 kPa BP</td>
<td>25.7%</td>
<td>14.2%</td>
</tr>
</tbody>
</table>
Table S6. MEA performances of porous Pt$_{61}$Te$_8$Rh$_{31}$ NRs/C and state-of-the-art Pt-based nanocatalysts as the cathodic catalysts from recent 5 years-published works in H$_2$-O$_2$ PEMFC medium (specific pressure, 80 °C and 100% relative humidity).

<table>
<thead>
<tr>
<th>Catalyst (Anode Side</th>
<th>Cathode Side)</th>
<th>Peak Power Density (mW cm$^{-2}$)</th>
<th>Anodic/Cathodic Pt Loading Amounts (mgPt cm$^{-2}$)</th>
<th>Ref.</th>
</tr>
</thead>
<tbody>
<tr>
<td>20% Commercial Pt/C</td>
<td>11.2% Porous Pt$_{61}$Te$<em>8$Rh$</em>{31}$ NRs/C</td>
<td>1976.1</td>
<td>0.10/0.10</td>
<td>This Work</td>
</tr>
<tr>
<td>20% Commercial Pt/C</td>
<td>20% Commercial Pt/C</td>
<td>1338.8</td>
<td>0.10/0.10</td>
<td></td>
</tr>
<tr>
<td>Pt-Based Catalyst</td>
<td>Pt-Based Catalyst</td>
<td>&gt; 1000</td>
<td>0.025/0.10</td>
<td>2025 U.S. DOE Target</td>
</tr>
<tr>
<td>Pt-Based Catalyst</td>
<td>Pt-Ni Nanocages/C</td>
<td>1280</td>
<td>0.30/0.30</td>
<td>Appl. Catal. B: Environ. 2017, 203, 927</td>
</tr>
<tr>
<td>Pt-Based Catalyst</td>
<td>Pt/C</td>
<td>1210</td>
<td>0.10/0.10</td>
<td></td>
</tr>
<tr>
<td>20% Commercial Pt/C</td>
<td>PtCo + Co$_3$N$_2$-C$_y$</td>
<td>1050</td>
<td>0.35/0.033</td>
<td>Science 2018, 362, 1276</td>
</tr>
<tr>
<td>20% Commercial Pt/C</td>
<td>PtCo + Co$_3$N$_2$-C$_y$</td>
<td>1420</td>
<td>0.35/0.035</td>
<td></td>
</tr>
<tr>
<td>20% Commercial Pt/C</td>
<td>Pt$_3$Co/ZC</td>
<td>740</td>
<td>0.35/0.043</td>
<td></td>
</tr>
<tr>
<td>46% Commercial Pt/C</td>
<td>PtNi Octahedra/C</td>
<td>~ 540</td>
<td>0.15/0.15</td>
<td>Nano Lett. 2018, 18, 2450</td>
</tr>
<tr>
<td>46% Commercial Pt/C</td>
<td>46% Commercial Pt/C</td>
<td>~ 490</td>
<td>0.15/0.15</td>
<td></td>
</tr>
<tr>
<td>20% Commercial Pt/C</td>
<td>1 L1$_{10}$-W-PtCo/C</td>
<td>NA</td>
<td>0.10/0.11</td>
<td>Angew. Chem. Int. Ed. 2019, 58, 15471</td>
</tr>
<tr>
<td>20% Commercial Pt/C</td>
<td>1 PtCo@Graphene + Co$_3$N$_2$-C$_y$</td>
<td>~ 880</td>
<td>0.15/0.12</td>
<td>J. Am. Chem. Soc. 2019, 141, 18083</td>
</tr>
<tr>
<td>20% Commercial Pt/C</td>
<td>1 PtCo@Graphene + Co$_3$N$_2$-C$_y$</td>
<td>~ 720</td>
<td>0.15/0.14</td>
<td></td>
</tr>
<tr>
<td>NA L L1$_{10}$-CoPt/Pt Nanoparticles/C</td>
<td>NA</td>
<td></td>
<td>0.10/0.10</td>
<td>Joule 2019, 3, 124</td>
</tr>
<tr>
<td>Pt/C 1 oh-PtNi(Mo)/C</td>
<td>NA</td>
<td></td>
<td>0.10/0.10</td>
<td>Nano Lett. 2019, 19, 6876</td>
</tr>
<tr>
<td>Pt/C 1 d-PtNi/C</td>
<td>NA</td>
<td></td>
<td>0.10/0.10</td>
<td></td>
</tr>
<tr>
<td>Commercial PtRu/C</td>
<td>PtCo@CNTs-MOF</td>
<td>1020</td>
<td>0.04/0.06</td>
<td>J. Mater. Chem. A 2019, 7, 19786</td>
</tr>
<tr>
<td>20% Commercial Pt/C</td>
<td>1 L1$_2$-PtZn/Pt/C</td>
<td>2000</td>
<td>0.10/0.104</td>
<td>Adv. Energy Mater. 2020, 10, 2000179</td>
</tr>
<tr>
<td>20% Commercial Pt/C</td>
<td>1 20% Commercial Pt/C</td>
<td>~ 1200</td>
<td>0.10/0.16</td>
<td></td>
</tr>
<tr>
<td>70% Commercial Pt/C</td>
<td>70% Commercial Pt/C with New GDL/Porous CNT Membrane</td>
<td>840</td>
<td>0.50/0.50</td>
<td>J. Mater. Chem. A 2020, 8, 5986</td>
</tr>
<tr>
<td>70% Commercial Pt/C</td>
<td>70% Commercial Pt/C with Commercial GDL/Porous CNT Membrane</td>
<td>634</td>
<td>0.10/0.10</td>
<td></td>
</tr>
<tr>
<td>20% Commercial Pt/C</td>
<td>PtFe/Pt-i-NPs/C</td>
<td>NA</td>
<td>0.08/0.02</td>
<td>Science 2021, 374, 459</td>
</tr>
<tr>
<td>20% Commercial Pt/C</td>
<td>PtCo/Pt-i-NPs/C</td>
<td>NA</td>
<td>0.08/0.02</td>
<td></td>
</tr>
<tr>
<td>20% Commercial Pt/C</td>
<td>PtNi/Pt-i-NPs/C</td>
<td>NA</td>
<td>0.08/0.20</td>
<td></td>
</tr>
<tr>
<td>20% Commercial Pt/C</td>
<td>PtCu/Pt-i-NPs/C</td>
<td>NA</td>
<td>0.08/0.20</td>
<td></td>
</tr>
<tr>
<td>20% Commercial Pt/C</td>
<td>1 20% Commercial Pt/C</td>
<td>NA</td>
<td>0.10/0.10</td>
<td></td>
</tr>
<tr>
<td>Commercial Pt/C</td>
<td>L1$_2$-Pt$_3$Co/FeN$_2$-C</td>
<td>NA</td>
<td>0.10/0.10</td>
<td>Energy Environ. Sci. 2021, 14, 4948</td>
</tr>
<tr>
<td>Commercial Pt/C</td>
<td>PtFe$_3$-C</td>
<td>NA</td>
<td>0.10/0.10</td>
<td>Proc. Natl. Acad. Sci. U.S.A. 2021, 118, e2104026118</td>
</tr>
<tr>
<td>60% Commercial Pt/C</td>
<td>1 Sub-Pt$_3$Co-MC</td>
<td>~ 1750</td>
<td>0.20/0.20</td>
<td></td>
</tr>
<tr>
<td>60% Commercial Pt/C</td>
<td>1 60% Commercial</td>
<td>~ 1100</td>
<td>0.20/0.20</td>
<td></td>
</tr>
<tr>
<td>Catalyst Description</td>
<td>Pressure</td>
<td>Current Density</td>
<td>Source</td>
<td></td>
</tr>
<tr>
<td>-----------------------------------------------------------</td>
<td>----------</td>
<td>-----------------</td>
<td>-------------------------</td>
<td></td>
</tr>
<tr>
<td>20% Commercial Pt/C 1 Pt1@Pt/NBP</td>
<td>844</td>
<td>0.10/0.045</td>
<td>ACS Catal. 2021, 11, 466</td>
<td></td>
</tr>
<tr>
<td>20% Commercial Pt/C 1 20% Commercial Pt/C</td>
<td>1140</td>
<td>0.10/0.13</td>
<td></td>
<td></td>
</tr>
<tr>
<td>40% Commercial Pt/C 1 Ru-Pt9,Co Octahedra/C</td>
<td>1140</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>40% Commercial Pt/C 1 Pt9,Co Octahedra/C</td>
<td>1164</td>
<td>0.30/0.05</td>
<td>Nano Lett. 2021, 21, 6625</td>
<td></td>
</tr>
<tr>
<td>40% Commercial Pt/C 1 40% Commercial Pt/C</td>
<td>1033</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pt-Based Catalyst 1 PtCoNi@NCNTs</td>
<td>700</td>
<td>0.21/0.07</td>
<td>Sci. Bull. 2021, 66, 2207</td>
<td></td>
</tr>
<tr>
<td>Pt-Based Catalyst 1 Commercial Pt/C</td>
<td>594</td>
<td>0.21/0.40</td>
<td></td>
<td></td>
</tr>
<tr>
<td>46.4% Commercial Pt/C 1 Pt-Fe-N-C</td>
<td>1080</td>
<td>0.10/0.015</td>
<td>Nat. Catal. 2022, 5, 503</td>
<td></td>
</tr>
<tr>
<td>46.4% Commercial Pt/C 1 Pt-N-C</td>
<td>320</td>
<td>0.10/0.10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Commercial Pt/C 1 Commercial Pt/C-46.4%</td>
<td>1370</td>
<td>0.10/0.10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>40% Commercial Pt/C 1 Pt9,C01,1-MC@Pt/C</td>
<td>2300</td>
<td>0.10/0.20</td>
<td>Energy Environ. Sci. 2022, 15, 278</td>
<td></td>
</tr>
<tr>
<td>40% Commercial Pt/C 1 40% Commercial Pt/C</td>
<td>1990</td>
<td>0.10/0.20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20% Commercial Pt/C 1 PtCo@NGNS</td>
<td>860</td>
<td>0.10/0.10</td>
<td>Angew. Chem. Int. Ed. 2022, 61, e202115835</td>
<td></td>
</tr>
<tr>
<td>NA 1 Pt9,3Zn22 Nanocubes/KB</td>
<td>1449.5</td>
<td>NA/0.15</td>
<td>Adv. Sci. 2022, 9, 2200147</td>
<td></td>
</tr>
<tr>
<td>NA 1 20% Commercial Pt/C</td>
<td>1149</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30% Commercial Pt/C 1 Pd@Pt91, Nanoparticles/C</td>
<td>1261</td>
<td>0.099/0.152</td>
<td>Nano Res. 2022, 15, 1892</td>
<td></td>
</tr>
<tr>
<td>30% Commercial Pt/C 1 30% Commercial Pt/C</td>
<td>~1200</td>
<td>0.102/0.298</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The specific pressure for fuel cell measurements is as shown in corresponding references.

NA: not available
Table S7. EXAFS parameters of Pt foil, PrTe NRs/C, porous Pt₉₅Te₅ NRs/C, PrTeRh NRs/C with different compositions, and porous PrTeRh NRs/C with different compositions.

<table>
<thead>
<tr>
<th>Sample</th>
<th>Bond type</th>
<th>CN</th>
<th>R (Å)</th>
<th>$\sigma^2$ (10⁻³Å²)</th>
<th>R-factor (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pt foil</td>
<td>Pt-Pt</td>
<td>12</td>
<td>2.76 ± 0.01</td>
<td>4.4 ± 0.2</td>
<td>0.1</td>
</tr>
<tr>
<td>Pr₉₅Te₅ NRs/C</td>
<td>Pt-Pt</td>
<td>8.3 ± 0.8</td>
<td>2.77 ± 0.02</td>
<td>10.6 ± 1.0</td>
<td>2.2</td>
</tr>
<tr>
<td></td>
<td>Pt-Te</td>
<td>2.9 ± 0.3</td>
<td>2.64 ± 0.02</td>
<td>8.8 ± 1.0</td>
<td></td>
</tr>
<tr>
<td>Pt₉₅Te₅Rh₁ NRs/C</td>
<td>Pt-Pt</td>
<td>2.0 ± 0.2</td>
<td>2.65 ± 0.02</td>
<td>5.2 ± 0.8</td>
<td>1.8</td>
</tr>
<tr>
<td></td>
<td>Pt-Te</td>
<td>5.5 ± 0.7</td>
<td>2.73 ± 0.02</td>
<td>8.5 ± 1.1</td>
<td></td>
</tr>
<tr>
<td>Pt₉₅Te₅Rh₂ NRs/C</td>
<td>Pt-Pt</td>
<td>6.7 ± 0.5</td>
<td>2.75 ± 0.02</td>
<td>8.2 ± 0.7</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pt-Te</td>
<td>2.4 ± 0.2</td>
<td>2.65 ± 0.01</td>
<td>6.1 ± 0.7</td>
<td>1.1</td>
</tr>
<tr>
<td>Pt₉₅Te₅Rh₃ NRs/C</td>
<td>Pt-Pt</td>
<td>9.1 ± 0.6</td>
<td>2.75 ± 0.01</td>
<td>6.2 ± 0.4</td>
<td>0.7</td>
</tr>
<tr>
<td></td>
<td>Pt-Pt</td>
<td>6.9 ± 0.6</td>
<td>2.74 ± 0.02</td>
<td>9.2 ± 0.8</td>
<td></td>
</tr>
<tr>
<td>porous Pr₉₅Te₅ NRs/C</td>
<td>Pt-Pt</td>
<td>2.5 ± 0.2</td>
<td>2.65 ± 0.01</td>
<td>5.9 ± 0.6</td>
<td>0.9</td>
</tr>
<tr>
<td>Pt₉₅Te₅Rh₂₄ NRs/C</td>
<td>Pt-Pt</td>
<td>0.7 ± 0.3</td>
<td>2.68 ± 0.02</td>
<td>4.6 ± 2.3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pt-Pt</td>
<td>9.1 ± 0.5</td>
<td>2.75 ± 0.01</td>
<td>6.9 ± 0.4</td>
<td>0.6</td>
</tr>
<tr>
<td>porous Pr₆₁Te₆Rh₃₁ NRs/C</td>
<td>Pt-Pt</td>
<td>0.8 ± 0.2</td>
<td>2.70 ± 0.02</td>
<td>1.8 ± 1.2</td>
<td>0.9</td>
</tr>
<tr>
<td></td>
<td>Pt-Pt</td>
<td>7.1 ± 0.5</td>
<td>2.73 ± 0.01</td>
<td>5.8 ± 0.6</td>
<td></td>
</tr>
<tr>
<td>porous Pr₆₂Te₁₃Rh₂₂ NRs/C</td>
<td>Pt-Pt</td>
<td>1.6 ± 0.2</td>
<td>2.71 ± 0.01</td>
<td>2.5 ± 0.8</td>
<td>1.4</td>
</tr>
<tr>
<td></td>
<td>Pt-Pt</td>
<td>5.4 ± 0.5</td>
<td>2.72 ± 0.01</td>
<td>5.4 ± 0.8</td>
<td></td>
</tr>
</tbody>
</table>

R, radial distance between absorber and backscatter atoms.

CN, coordination number.

$\sigma^2$, Debye-Waller factor value.

The passive electron reduction factor ($S_0^2$) was fixed to 0.81, as determined from Pt foil fitting.

R-factor (%) indicates the goodness of the fit.
Table S8. EXAFS parameters of Rh foil, PtTeRh NRs/C with different compositions, and porous PtTeRh NRs/C with different compositions.

<table>
<thead>
<tr>
<th>Sample</th>
<th>Bond type</th>
<th>CN</th>
<th>R (Å)</th>
<th>²σ (10⁻³Å²)</th>
<th>R-factor (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rh foil</td>
<td>Rh-Rh</td>
<td>12</td>
<td>2.69 ± 0.01</td>
<td>3.9 ± 0.3</td>
<td>0.9</td>
</tr>
<tr>
<td>Pt₃Te₃Rh₁ NRs/C</td>
<td>Rh-Te</td>
<td>4.2 ± 0.2</td>
<td>2.58 ± 0.02</td>
<td>1.7 ± 0.7</td>
<td>1.5</td>
</tr>
<tr>
<td></td>
<td>Rh-Pt</td>
<td>9.8 ± 0.4</td>
<td>2.72 ± 0.02</td>
<td>2.5 ± 0.5</td>
<td></td>
</tr>
<tr>
<td>Pt₃Te₃Rh₂ NRs/C</td>
<td>Rh-Te</td>
<td>4.2 ± 0.4</td>
<td>2.52 ± 0.02</td>
<td>1.2 ± 1.2</td>
<td>2.0</td>
</tr>
<tr>
<td></td>
<td>Rh-Pt</td>
<td>14.8 ± 1.1</td>
<td>2.68 ± 0.02</td>
<td>8.4 ± 1.3</td>
<td></td>
</tr>
<tr>
<td>Pt₃Te₃Rh₃ NRs/C</td>
<td>Rh-Te</td>
<td>5.0 ± 0.2</td>
<td>2.53 ± 0.02</td>
<td>4.2 ± 2.5</td>
<td>1.3</td>
</tr>
<tr>
<td></td>
<td>Rh-Pt</td>
<td>8.2 ± 0.3</td>
<td>2.68 ± 0.02</td>
<td>3.1 ± 2.4</td>
<td></td>
</tr>
<tr>
<td>porous Pt₆₀Te₃Rh₃₄ NRs/C</td>
<td>Rh-Te</td>
<td>6.9 ± 0.3</td>
<td>2.63 ± 0.02</td>
<td>4.4 ± 1.3</td>
<td>0.7</td>
</tr>
<tr>
<td></td>
<td>Rh-Pt</td>
<td>6.3 ± 0.3</td>
<td>2.72 ± 0.02</td>
<td>11.1 ± 1.9</td>
<td></td>
</tr>
<tr>
<td>porous Pt₆₁Te₃Rh₃₁ NRs/C</td>
<td>Rh-Te</td>
<td>9.3 ± 0.6</td>
<td>2.71 ± 0.02</td>
<td>3.0 ± 0.7</td>
<td>2.1</td>
</tr>
<tr>
<td></td>
<td>Rh-Pt</td>
<td>3.5 ± 0.3</td>
<td>2.73 ± 0.02</td>
<td>1.6 ± 1.0</td>
<td></td>
</tr>
<tr>
<td>porous Pt₆₂Te₃Rh₃₂ NRs/C</td>
<td>Rh-Te</td>
<td>5.7 ± 0.4</td>
<td>2.69 ± 0.02</td>
<td>5.2 ± 2.6</td>
<td>0.9</td>
</tr>
<tr>
<td></td>
<td>Rh-Pt</td>
<td>7.5 ± 0.3</td>
<td>2.73 ± 0.02</td>
<td>5.6 ± 1.4</td>
<td></td>
</tr>
</tbody>
</table>

R, radial distance between absorber and backscatter atoms.
CN, coordination number.
²σ, Debye-Waller factor value.
The passive electron reduction factor (S₀²) was fixed to 0.56, as determined from Rh foil fitting.
R-factor (%) indicates the goodness of the fit.