Improved synthesis and hydrothermal stability of Pt/C catalysts based on size-controlled nanoparticles


Supporting information

Fig. S1. TEM images of catalysts prepared by a) ex situ b) in situ 1 and c) in situ 2 methods at PVP/Pt = 100 and NaBH₄/Pt = 10; (samples 2, 4 and 6, respectively). Bar length: 20 nm.

Fig. S2. TEM images of catalysts prepared by a) in situ 1 and b) in situ 2 methods at PVP/Pt = 10 and NaBH₄/Pt = 26; (samples 7 and 8, respectively). Bar length: 20 nm.
Table S1. Pt NPs synthesis conditions, number average diameter, surface average diameters and standard deviation.

<table>
<thead>
<tr>
<th>Sample</th>
<th>Reducing agent</th>
<th>NaBH$_4$/metal (mol/mol)</th>
<th>PVP/Metal (mol/mol)</th>
<th>$d_n$ (nm)</th>
<th>$d_s$ (nm)</th>
<th>$\sigma$ (nm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pt-NaBH$_4$10-PVP10</td>
<td>NaBH$_4$</td>
<td>10</td>
<td>10</td>
<td>4.82</td>
<td>4.00±0.12*</td>
<td>1.18* &lt; 1.26 &lt; 1.34*</td>
</tr>
<tr>
<td>Pt-NaBH$_4$10-PVP100</td>
<td>NaBH$_4$</td>
<td>10</td>
<td>100</td>
<td>3.63</td>
<td>3.17±0.14*</td>
<td>0.75* &lt; 0.84 &lt; 0.95*</td>
</tr>
</tbody>
</table>

\[
\overline{\frac{n_i \cdot d_i}{n_i}} ; \quad \overline{\frac{n_i \cdot d_i^4}{n_i}} ; \quad \sigma = \text{standard deviation}
\]

$d_n$ = number average diameter; $d_s$ = surface average diameter; $\sigma$ = standard deviation

* 95% confidence intervals calculated using MATLAB software
Figure S7. Representative TEM image of a sample synthesized by chemical reduction with NaBH₄ without PVP.

Figure S8. Nanoparticle size distribution for a sample synthesized by chemical reduction with NaBH₄ without PVP.

Figure S9. Representative TEM image of a sample synthesized by incipient wetness impregnation.

Figure S10. Nanoparticle size distribution for a sample synthesized by incipient wetness impregnation.

Fig S11. Representative TEM images of the samples synthesized by in situ routes and subjected to pyrolysis at 500 °C (a) 3: in situ 1, PVP/Pt = 10; (b) 4: in situ 1, PVP/Pt = 100; and (c) 6 in situ 2, PVP/Pt = 100.