Electronic Supplementary Information (ESI)

The partially controllable growth trend of carbon nanoparticles in solid-state pyrolysis of organometallic precursor by introducing POSS units, and their magnetic properties

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**Scheme S1.** Synthetic pathway of PT.
Figure S1. IR spectra of 2, T and PT.

Figure S2. TGA thermograms of 2, T and PT measured under nitrogen at a heating rate of 10 °C min⁻¹.

Thermal properties and pyrolysis program

The pyrolysis program, such as heating rate, temperature and holding time had a significant influence on the structure of the yielded CNPs. Generally, the samples were first heated to their decomposition temperature of the Co-carbonyl groups and held at this temperature for several hours, then heated to a high temperature and held there for another several hours. In order to determine our pyrolysis program, the thermal properties of compounds 2, T and PT were investigated by using
thermogravimetric analysis. The thermal-decomposition temperatures ($T_d$, corresponding to 5% weight loss) of T and PT were ~180 °C. Thus, we determined the pyrolysis program as following: powders of the organometallic precursor were placed in quartz tubes sealed under high vacuum, then suffered to different heating programs in a furnace. The samples were first heated slowly to their decomposition temperature 180 °C, held for two hours to ensure the completely decomposition of the Co complexes, and then heated to a higher temperature where the sample was held for several hours. After slowly cooled to room temperature, the obtained products were characterized by using powder X-ray diffraction (XRD), scanning electron (SEM) and transmission electron (TEM) microscopy, energy-dispersive spectroscopy (EDS) and vibrating sample magnetometer.
Figure S3. HRTEM images of the materials obtained through thermolysis of T and PT. (a, b) for T-700-24h; (c, d) for T-850-8h; (e) for PT-700-24h; (f) for PT-850-8h.
Figure S4. SEM-EDX spectra of the materials obtained through thermolysis of compounds: a) T-700-8h, b) T-700-24h, c) T-800-8h, d) T-850-8h, e) PT-700-24h and f) PT-850-8h.

Table S1. Compositions of organometallic precursors and their pyrolysis products.

<table>
<thead>
<tr>
<th>Sample</th>
<th>C (%)</th>
<th>Co (%)</th>
<th>Si (%)</th>
<th>O (%)</th>
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<tbody>
<tr>
<td>T</td>
<td>47.1</td>
<td>24.3</td>
<td>0.00</td>
<td>26.4</td>
</tr>
<tr>
<td>T-700-8h</td>
<td>76.2</td>
<td>23.8</td>
<td>-a</td>
<td>-</td>
</tr>
<tr>
<td>T-700-24h</td>
<td>70.2</td>
<td>29.8</td>
<td>-</td>
<td>-</td>
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<tr>
<td>T-800-8h</td>
<td>67.0</td>
<td>33.0</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>T-850-8h</td>
<td>63.7</td>
<td>36.3</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>PT</td>
<td>43.9</td>
<td>9.0</td>
<td>17.1</td>
<td>24.4</td>
</tr>
<tr>
<td>PT-700-24h</td>
<td>38.9</td>
<td>16.2</td>
<td>18.5</td>
<td>26.4</td>
</tr>
<tr>
<td>PT-850-8h</td>
<td>27.1</td>
<td>24.6</td>
<td>18.4</td>
<td>29.9</td>
</tr>
</tbody>
</table>

a. The symbol of “-” represents the element was not detected.
Figure S5. TEM-EDX spectra of (a) T-700-24h and (b) T-850-8h.
Figure S6. $^1$H NMR spectrum of 1 in CDCl$_3$.

Figure S7. $^{13}$C NMR spectrum of 1 in CDCl$_3$. 
Figure S8. MALDI-TOF spectrum of 1.

Figure S9. $^1$H NMR spectrum of 2 in CDCl$_3$. 
Figure S10. $^{13}$C NMR spectrum of 2 in CDCl$_3$.

Figure S11. MALDI-TOF spectrum of 2.
Figure S12. $^1$H NMR spectrum of PT in CDCl$_3$.

Figure S13. $^{13}$C NMR spectrum of PT in CDCl$_3$. 
Figure S14. $^{29}$Si NMR spectra of 2 and PT in CDCl$_3$. 