Electronic Supplementary Information (ESI)

Dodecylamine-derived thin carbon-coated single Fe₃O₄ nanocrystals for advanced lithium ion batteries

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**Fig. S1** FE-SEM images of the precursors (a) with and (b) without DDA. XRD patterns of precursors and synthesized samples after heat treatment at 500 °C for 4 h under argon (c) with and (d) without DDA.
Fig. S2 (a) FE-SEM image (inset: TEM image), (b) XRD pattern, (c) TGA curve, and (d) N\textsubscript{2} adsorption-desorption isotherms (inset shows the pore size distribution by the BJH method) of the OC-Fe\textsubscript{3}O\textsubscript{4} sample, which was synthesized without dodecylamine and then carbon layer added to the surface.
Fig. S3 The second CV curves of (a) OC-Fe$_3$O$_4$ during the initial three cycles at a scan rate of 0.1 mV s$^{-1}$. (b) The equivalent circuit model for fitting the EIS plots. The second CV curves of (c) IOC-Fe$_3$O$_4$ and (d) OC-Fe$_3$O$_4$ in the voltage range of 0.01–3 V vs. Li$^+$/ Li$^+$ at various scan rates from 0.04 to 10 mV s$^{-1}$. Charge and discharge profiles of (e) IOC-Fe$_3$O$_4$ and (f) OC-Fe$_3$O$_4$ during 300 cycles at a current density of 1 A g$^{-1}$. 
Table S1. The carbon contents and electrochemical performances of various Fe₃O₄ compositied or coated with carbonaceous materials.

<table>
<thead>
<tr>
<th>Materials</th>
<th>Carbon content (wt.%)</th>
<th>Total carbon content (wt%)</th>
<th>Current density (mA g⁻¹)</th>
<th>Capacity (mAh g⁻¹)</th>
<th>Ref.</th>
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<tbody>
<tr>
<td>Fe₃O₄@C</td>
<td>4.2</td>
<td>14.2</td>
<td>3000</td>
<td>563</td>
<td>In this study</td>
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<tr>
<td>Fe₃O₄@C</td>
<td>21.5</td>
<td>36.5</td>
<td>4620</td>
<td>190</td>
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<td>Fe₃O₄@C</td>
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<td>74.6</td>
<td>800</td>
<td>118</td>
<td>2</td>
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<tr>
<td>Fe₃O₄@C</td>
<td>18</td>
<td>28</td>
<td>1000</td>
<td>702</td>
<td>3</td>
</tr>
<tr>
<td>Fe₃O₄@C</td>
<td>19</td>
<td>29</td>
<td>1000</td>
<td>290</td>
<td>4</td>
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<tr>
<td>Fe₃O₄@C</td>
<td>17</td>
<td>27</td>
<td>2000</td>
<td>341</td>
<td>5</td>
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<tr>
<td>N-doped carbon coated Fe₃O₄</td>
<td>16</td>
<td>31</td>
<td>2000</td>
<td>396</td>
<td>6</td>
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<td>Graphene@Fe₃O₄</td>
<td>13.3</td>
<td>23.3</td>
<td>1750</td>
<td>520</td>
<td>7</td>
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<td>Graphene@Fe₃O₄</td>
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<td>45.2</td>
<td>2500</td>
<td>393</td>
<td>8</td>
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<td>Graphene oxide@Fe₃O₄</td>
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<td>55.5</td>
<td>2000</td>
<td>385</td>
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<td>Porous carbon fiber@Fe₃O₄</td>
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<td>59.2</td>
<td>2000</td>
<td>523</td>
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References

Table S2. Resistance parameters fitted by the equivalent circuit model (Fig. S3b) for IOC-Fe$_3$O$_4$ and OC-Fe$_3$O$_4$.

<table>
<thead>
<tr>
<th>Sample</th>
<th>Process</th>
<th>$R_s$ (Ω)</th>
<th>$R_{SEI}$ (Ω)</th>
<th>$R_{CT}$ (Ω)</th>
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<tr>
<td></td>
<td>Discharge</td>
<td>4.69</td>
<td>17.37</td>
<td>36.49</td>
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<td>IOC-Fe$_3$O$_4$</td>
<td>Charge</td>
<td>4.28</td>
<td>18.81</td>
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<td>OC-Fe$_3$O$_4$</td>
<td>Discharge</td>
<td>6.14</td>
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<td></td>
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<td>35.4</td>
<td>38.82</td>
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