Supplementary Information

**In situ construction of amorphous hierarchical iron oxyhydroxide nanotubes via selective dissolution-regrowth strategy for enhanced lithium storage**

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Figure S1. (a) The XRD patterns of FVO-NWs, FeOOH-HNTs and FeOOH-HNTs-G. (b) Raman spectra of FeOOH-HNTs and FeOOH-HNTs-G.

Figure S2. (a) XRD pattern and (b) SEM image of FVO-NWs-G.

Figure S3. The TG-DSC curves of (a) FeOOH-HNTs and (b) FeOOH-HNTs-G.
Figure S4. (a) The Fe 2p XPS spectra of FeOOH-HNTs and FeOOH-HNTs-G and (b) V 2p XPS spectrum of FeOOH-HNTs.

Figure S5. The EDS spectrum of FeOOH-HNTs.
Figure S6. Nitrogen adsorption–desorption isotherms and corresponding pore size distribution plots of (a, d) FVO-NWs, (b, e) FeOOH-HNTs and (c, f) FeOOH-HNTs-G.

Figure S7. TEM images of sample during transformation from FVO-NWs to FeOOH-HNTs.
Figure S8. The HAADF image and the EDS elemental mappings of FVO-NWs after treatment with NaOH solution for 20 mins.

Figure S9. FESEM images of samples obtained from FVO-NWs by etching with (a) 0.02 M and (b) 0.5 M NaOH solution.
Figure S10. XRD patterns of samples after selective dissolution treatment for different times: 10, 30 and 60 min.

Figure S11. The SAED patterns of (a) FVO-NWs and (b) FeOOH-HNTs.
Figure S12. Digital photographs of FVO-NWs treated in NaOH solution for different time (unit: min).

Figure S13. FESEM images of (a) copper vanadate, (b) cobalt molybdate and (c) manganese molybdate nanowires.
Figure S14. The EDS spectrum of manganese oxide hierarchical nanowires.

Figure S15. (a) The CV curves of FeOOH-HNTs at 0.1 mV s\(^{-1}\) and (b) The cycling performance of FVO-NWs at 200 mA g\(^{-1}\).
Figure S16. Nyquist plots of FeOOH-HNTs and FeOOH-HNTs-G.

Figure S17. The sodium storage performance of FeOOH-HNTs-G. (a) Rate performance, (b) the corresponding charge/discharge curves at 100 mA g\(^{-1}\), and (c) cycling performance at 500 mA g\(^{-1}\).
Table S1. The comparison for cycling performance of FeOOH-based LIBs anode materials

<table>
<thead>
<tr>
<th>Materials</th>
<th>Cycle number</th>
<th>Capacity after cycling (mAh g(^{-1}))</th>
<th>Current density (mA g(^{-1}))</th>
<th>Ref.</th>
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<tr>
<td>Amorphous FeOOH/ rGO composites</td>
<td>600</td>
<td>767</td>
<td>1000</td>
<td>S1</td>
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<tr>
<td>Atomically thin $\gamma$ FeOOH nanosheets</td>
<td>100</td>
<td>850</td>
<td>200</td>
<td>S2</td>
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<tr>
<td>FeOOH nanorod/ rGO composites</td>
<td>200</td>
<td>1135</td>
<td>1000</td>
<td>S3</td>
</tr>
<tr>
<td>$\beta$-FeOOH nanorods</td>
<td>600</td>
<td>$\sim$700(^a)</td>
<td>500</td>
<td>S4</td>
</tr>
<tr>
<td>3500</td>
<td>$\sim$600(^b)</td>
<td></td>
<td>2000</td>
<td></td>
</tr>
<tr>
<td>Hexapods $\alpha$-FeOOH/rGO composites</td>
<td>50</td>
<td>610</td>
<td>100</td>
<td>S5</td>
</tr>
<tr>
<td>FeOOH particles/single-walled carbon nanotube composites</td>
<td>180</td>
<td>758</td>
<td>400</td>
<td>S6</td>
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<tr>
<td>$\beta$-FeOOH nanorod on carbon cloth</td>
<td>150</td>
<td>$\sim$900(^c)</td>
<td>1000</td>
<td>S7</td>
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<tr>
<td>$\beta$-FeOOH nanorods /graphene composites</td>
<td>100</td>
<td>650</td>
<td>100</td>
<td>S8</td>
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<td>Graphene decorated amorphous FeOOH hierarchical nanotubes</td>
<td>900/1800</td>
<td>568/463</td>
<td>1000</td>
<td>This work</td>
</tr>
</tbody>
</table>

\(^a\) The electrode containing 70% $\beta$-FeOOH and 10% graphite, and the specific capacity is calculated based on the mass of $\beta$-FeOOH.

\(^b\) The electrode containing 50% $\beta$-FeOOH and 30% graphite, and the specific capacity is calculated based on the mass of $\beta$-FeOOH.

\(^c\) The estimated value after subtracting the capacity contribution of carbon cloth.


S2. Song Y, Cao Y, Wang J, et al. Bottom-up approach design, band structure, and lithium storage
properties of atomically thin gamma-FeOOH nanosheets. *ACS Appl Mater Interfaces*, 2016, 8(33): 21334-21342


Zhang X, Du Y. Gelatin assisted wet chemistry synthesis of high quality β-FeOOH nanorods anchored on graphene nanosheets with superior lithium-ion battery application. *RSC Adv*, 2016, 6(21): 17504-17509