Supporting Information

Hydrothermal synthesis of hierarchical SnO$_2$ microspheres for gas sensing and lithium-ion batteries applications: Fluoride-mediated formation of solid and hollow structures

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Figure S1. TEM image and XRD pattern of SnO$_2$ nanoparticles obtained by hydrothermal treatment of the single precursor SnCl$_4$$\cdot$5H$_2$O at 180$^\circ$C for 24h, without addition of fluorides.

Figure S2. Nitrogen adsorption-desorption isotherms of the hierarchical SnO$_2$ solid/hollow microspheres synthesized by using NH$_4$F/NaF as controlling agents, respectively.

Table S1. Relative atomic concentration analyzed through XPS

<table>
<thead>
<tr>
<th>Elements</th>
<th>O1s</th>
<th>F1s</th>
<th>Sn3d5</th>
</tr>
</thead>
<tbody>
<tr>
<td>SnO$_2$ without sintering</td>
<td>62.42</td>
<td>10.63</td>
<td>26.95</td>
</tr>
<tr>
<td>SnO$_2$ sintered at 700$^\circ$C for 4h</td>
<td>64.74</td>
<td>2.29</td>
<td>32.97</td>
</tr>
</tbody>
</table>
Figure S3. XRD patterns of SnO₂ samples synthesized with different F(NH₄F)/Sn mole ratio. (a) R_{F/Sn} = 0, (b) R_{F/Sn} = 3, (c) R_{F/Sn} = 4, (d) R_{F/Sn} = 5.

Figure S4. XRD patterns of SnO₂ samples synthesized at 180°C for different hydrothermal time with R_{F/Sn} = 4.77. (a) 1h, (b) 5h, (c) 16h, (d) 24h.
Figure S5. Gas response ($R_a/R_g$) of the hierarchical SnO$_2$ solid and hollow spheres upon exposure to different concentrations of ethanol.

Figure S6. Response time (a), recovery time (b) and sensitivity (c) of the hierarchical SnO$_2$ solid and hollow spheres sensors to different kinds of gases with concentration of 50 ppm.