Electronic Supplementary information

Facile synthesis of SnO$_2$@carbon nanocomposite for lithium ion battery

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S1: The rate performance at different current densities and Cycling performances

![Graph showing rate performance and cycling performances of SnC-1 and SnC-3](image)

Figure. S1 The rate performance, at different current densities and Cycling performances of SnC-1, and SnC-3 between 0.01 and 3V for lithium ion batteries for 50 cycles.

The 50th discharge capacities of pristine SnC-0, SnC-1, SnC-2 and SnC-3 were 41, 135, 808 and 164 mAhg-1. This study, demonstrates SnC-2 shows better stability compared to other samples. Therefore further rate performance and cyclability study (200 cycles) carried out for pristine and SnC-2 sample.

S2: Columbic efficiency of SnC-0 and SnC-2 sample

![Graph showing columbic efficiency of SnC-0 and SnC-2](image)

Figure. S2 The columbic efficiency of the SnO2 and SnO2@C nanocomposites (SnC-2) electrodes for lithium ion batteries.

S3: Tap density of nanocomposites powder

As procedure given in report tapped density of a powder is the ratio of the mass of the powder to the volume occupied by the powder after it has been tapped for a defined period of time. 1, 2, 3The tapped density of a powder represents its random dense packing. It is measured using eq.

\[
\text{Tapped Density (g/mL) = M} \times \text{Vf}
\]

1, 2, 3
Where, $M$ = mass in grams, $V_f$ = tapped volume in milliliters. The tap density of SnC-0, SnC-1, SnC-2 and SnC-3 are 1.225, 0.981, 0.668, and 0.386 g/mL.

**S4: Press density of Anode**
Press density of the electrode film is also measured via gravimetric method using following eq.

$$d = \frac{m}{A \times \rho}$$

Where, $d$ = film thickness, $m$ = mass, $\rho$ = density, and $A$ = area covered. The density of SnC-0 SnC-1, SnC-2 and SnC-3 electrodes before roll press are 0.724, 0.25, 0.692 and 0.394 g/cc which is increased 0.94, 0.36, 1.2454 and 0.743 g/cc after roll press respectively. Density of the electrode increases with the concentration of the citric acid. 5, 6, 7

**Table S1. Comparison of the SnO2/C composites for their electrochemical performance**

<table>
<thead>
<tr>
<th>No</th>
<th>Current density</th>
<th>Capacity mAh$^{-1}$ (at initial Cycle)</th>
<th>Rate performance capacity (mAhg$^{-1}$) @ current density (cycle)</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>250 mAg$^{-1}$</td>
<td>1946</td>
<td>1050@250 mAg$^{-1}$ (130)</td>
<td>Co$_2$Sn$_2$/SnO$_2$ on Cu foam$^4$</td>
</tr>
<tr>
<td>2.</td>
<td>100 mAg$^{-1}$</td>
<td>1020</td>
<td>474@1000 mAg$^{-1}$ (50)</td>
<td>CuSnO$_2$/Sn$_2$O$_3$ $^5$</td>
</tr>
<tr>
<td>3.</td>
<td>100 mAg$^{-1}$</td>
<td>684</td>
<td>494@100 mAg$^{-1}$ (200)</td>
<td>SnO$_2$@carbon for Na ion battery$^10$</td>
</tr>
<tr>
<td>4.</td>
<td>0.1A/g</td>
<td>2010</td>
<td>500@0.1 Ag$^{-1}$ (40)</td>
<td>SnO$_2$ nanotube$^11$</td>
</tr>
<tr>
<td>5.</td>
<td>0.2C</td>
<td>1267</td>
<td><a href="mailto:674@0.2C">674@0.2C</a> (35)</td>
<td>Ni-doped SnO$_2$ $^{12}$</td>
</tr>
<tr>
<td>6.</td>
<td>50 mAg$^{-1}$</td>
<td>2805</td>
<td>537@50 mAg$^{-1}$ (50)</td>
<td>graphene–TiO$_2$–SnO$_2$ $^{13}$</td>
</tr>
<tr>
<td>7.</td>
<td>0.1C</td>
<td>1580</td>
<td><a href="mailto:404@0.1C">404@0.1C</a> (50)</td>
<td>TiN surface modified SnO$_2$ $^{14}$</td>
</tr>
<tr>
<td>8.</td>
<td>500 mAg$^{-1}$</td>
<td>1700</td>
<td>500@500 mAg$^{-1}$ (20)</td>
<td>Carbon-Coated SnO$_2$ $^{15}$</td>
</tr>
<tr>
<td>9.</td>
<td>100 mAg$^{-1}$</td>
<td>964</td>
<td>420@100 mAg$^{-1}$ (100)</td>
<td>SnO$_2$@carbon composite nanofibers$^{16}$</td>
</tr>
<tr>
<td>10.</td>
<td>C/20</td>
<td>460</td>
<td>500@1C (20)</td>
<td>SnO$_2$/Mesoporous Carbon$^{17}$</td>
</tr>
</tbody>
</table>

| 8. | 50 mAg$^{-1}$   | 1850                                   | 119@50 mAg$^{-1}$ (200)                         | Present work (SnO$_2$) |
| 9. | 50 mAg$^{-1}$   | 2581                                   | 725@50 mAg$^{-1}$ (200)                         | Present work (SnO$_2$@C) |

**Notes and references**
1. Zhang, Y.; Wang, Z.-B.; Nie, M.; Yu, F.-D.; Yun-Fei, X.; Liu, B.-S.; Xue, Y.; Zheng, L.-L.; Wu, J., A simple method for industrialization to enhance the tap density of LiNi0.5Co0.2Mn0.3O2 cathode material for high-specific volumetric energy lithium-ion batteries. *RSC Advances* 2016, 6 (70), 65941-65949.


