Supplementary Information

Porous silicon filled with Pd/WO$_3$-ZnO composite thin film for enhanced H$_2$ gas-sensing performance

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Figure S1: (a) The FE-SEM micrograph and (b) EDS spectra of bare ZnO sensing layer.

Figure S1 indicates that the silicon pores are uniformly filled with ZnO. The Zn and O elements are present in stoichiometric ratio.
**Figure S2**

(a)-(b) FE-SEM images and corresponding EDS spectra of Pd decorated WO$_3$-ZnO thin films with varying Pd concentration and (c) The sensing response versus Pd concentration curves.

Figure S2 (c) Depicts that as Pd concentration rises the response to 100 ppm H$_2$ at 200°C increases up to 1.74 at%. Thereafter, response starts to decline as Pd concentration further increases to 2.95 at%.
**Figure S3**

Figure S3: Response/recovery time variation versus humidity conditions (from 0-90% RH) for Pd/WO$_3$-ZnO composite layer towards 100 ppm H$_2$ at 200°C.

Figure S3 shows that the at the same H$_2$ concentration response and recovery time continuously enhances with increasing up to 90% RH.
Figure S4. The schematic view of the Pd/WO$_3$-ZnO composite sensor on porous silicon with the silver (Ag) paste as top electrodes.
Table S1: Brief summary of previous reported literature on WO$_3$ and ZnO semiconductor oxide based hydrogen gas sensor.

<table>
<thead>
<tr>
<th>Sensor (metal oxide)</th>
<th>Fabrication technique</th>
<th>H$_2$ ppm</th>
<th>Operating Temp.(°C)</th>
<th>Sensing response</th>
<th>Response/recovery time</th>
<th>Ref.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pd/ZnO-PSi</td>
<td>RF sputtering</td>
<td>2000</td>
<td>RT</td>
<td>4.82</td>
<td>408 s/420 s</td>
<td>[3]</td>
</tr>
<tr>
<td>Pd/WO$_3$-ZnO-PSi</td>
<td>DC sputtering</td>
<td>100</td>
<td>200</td>
<td>16.8</td>
<td>16 sec/62 sec</td>
<td>Present work</td>
</tr>
</tbody>
</table>

Present work
References

