**Supporting information**

**Table S1.** Comparison of gas-sensing characteristics and response time of disordered porous SnO$_2$ matrix material and CuO/SnO$_2$ aerogel composite material.

<table>
<thead>
<tr>
<th>NOx conc. (ppm) →</th>
<th>100</th>
<th>50</th>
<th>30</th>
<th>10</th>
<th>5</th>
<th>3</th>
<th>2</th>
<th>1</th>
<th>100</th>
<th>50</th>
<th>30</th>
<th>10</th>
<th>5</th>
<th>3</th>
<th>2</th>
<th>1</th>
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<tr>
<td>Disordered porous SnO$_2$ material</td>
<td>54</td>
<td>52</td>
<td>50</td>
<td>44</td>
<td>40</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>19.5</td>
<td>21</td>
<td>25</td>
<td>25.5</td>
<td>26</td>
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<tr>
<td>Disordered porous CuO/SnO$_2$ aerogel composite material</td>
<td>74</td>
<td>67</td>
<td>66</td>
<td>64.8</td>
<td>47</td>
<td>40.7</td>
<td>23</td>
<td>15</td>
<td>7</td>
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**Table S2.** Comparison of gas-sensing characteristics of disordered porous CuO/SnO$_2$ sensor towards the different gas.

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<th>Gas Conc.(ppm) →</th>
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<th>5</th>
<th>3</th>
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<td>NOx</td>
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<td>67</td>
<td>66</td>
<td>65</td>
<td>64.8</td>
<td>47</td>
<td>40.7</td>
<td>23</td>
<td>15</td>
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