Supplementary Information

Photoelectric properties and charge dynamics for a set of solid state solar cells with Cu₄Bi₄S₉ as absorber layer†

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Supplementary Tables

Table SI1 The efficiencies of four types of cells with different carrier mobility in sensitized electrodes.

<table>
<thead>
<tr>
<th>sensitized electrodes</th>
<th>carrier mobility (cm²V⁻¹s⁻¹)</th>
<th>efficiency (%)</th>
<th>carrier mobility (cm²V⁻¹s⁻¹)</th>
<th>efficiency (%)</th>
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</thead>
<tbody>
<tr>
<td>In₂O₃ electrode</td>
<td>11.8</td>
<td>5.6</td>
<td>14.2</td>
<td>6.2</td>
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<tr>
<td>ZnO electrode</td>
<td>12.7</td>
<td>4.2</td>
<td>16.4</td>
<td>4.8</td>
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<tr>
<td>TiO₂ electrode</td>
<td>26.4</td>
<td>5.0</td>
<td>38.5</td>
<td>5.5</td>
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<tr>
<td>SnO₂ electrode</td>
<td>10.5</td>
<td>3.3</td>
<td>12.6</td>
<td>3.9</td>
</tr>
</tbody>
</table>
**Supplementary Figures**

**Fig. S11** The schematic diagram of sandwich structure consisting of ITO (indium tin oxide) and sample in the steady state and electric field induced-surface photovoltage spectroscopy. ($E_c$: the bottom of conduction band; $E_v$: the top of valence band; $E_f$: the Fermi energy level; $\Delta V$: the difference of different surface potential; $V_s^0$: the surface potential before illumination; $V_s^1$: the surface potential after illumination; $V_s^1 < 0$; $h\nu$: the incident photon energy).
**Fig. S12** ((a) and (b)) Low-magnification SEM images of CBS nanoribbons.
**Fig. S13** (a), (b), (c) and (d) High-magnification SEM images of CBS nanoribbons.
**Fig. SI4** SEM images of (a) In$_2$O$_3$, (b) ZnO, (c) TiO$_2$, and (d) SnO$_2$ thin films, respectively.
**Fig. S15** ((a), (b), (c) and (d)) TEM images of CBS nanoribbons.
Fig. S16 The transport mechanism of photogenerated charges under zero and positive bias in four sensitized electrodes ($E_c$: the bottom of conduction band; $E_v$: the top of valence band; $E_f$: the Fermi energy level; $\Delta E_c$: the difference of conduction band edges at the interface; $\Delta E_v$: the difference of valence band edges at the interface; NHE: the normal hydrogen electrode; AVS: the absolute vacuum energy scale; $h\nu$: the energy of photon).
**Fig. SI7** The plots of $F(R)h\nu$ against the photo energy about (a) In$_2$O$_3$, (b) ZnO, (c) TiO$_2$, and (d) SnO$_2$, respectively.