Supplementary Information

Controlled growth of vertically aligned ultrathin In$_2$S$_3$ nanosheet arrays for photoelectrochemical water splitting

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Fig. S1 Optical images of In$_2$S$_3$ NSAs grown on FTO substrates with (a) different reaction times and (b) In$^{3+}$ concentrations.

Fig. S2 Optical image of a home-made photoanode based on In$_2$S$_3$ NSAs.
**Fig. S3** XRD patterns of In$_2$S$_3$ NSAs prepared with varied In$^{3+}$ concentrations.

**Fig. S4** (a) Transmission spectra, (b) reflection spectra, (c) absorption spectra and (d) energy bandgap determination of the In$_2$S$_3$ NSAs prepared with varied In$^{3+}$ concentrations.
Fig. S5 XRD patterns of FTO substrate, pristine In$_2$S$_3$-2h NSAs and In$_2$S$_3$/ZnO-100 min NSAs.

Fig. S6 Energy bandgap determination of the ZnO film grown on FTO substrate with the sputtering time of 100 min (thickness: 350 nm).
Fig. S7 (a) Cross-sectional SEM image, (b) LSV curve and (c) Amperometric I-t curve at 1.23 V vs. RHE under chopped AM 1.5G simulated solar illumination for the ZnO thin film with the deposition time of 100 min.

Fig. S8 LSV curves of the In$_2$S$_3$/ZnO-x min NSAs at 1.23 V vs. RHE under chopped AM 1.5G simulated solar illumination: (a-d) 10, 20, 50 and 150 min, respectively.
Fig. S9 Absorption spectra of the In$_2$S$_3$-2h and In$_2$S$_3$/ZnO-100 min NSAs.

Fig. S10 Time-resolved PL spectra of the In$_2$S$_3$-2h and In$_2$S$_3$/ZnO-100 min NSAs.
Fig. S11 Amperometric I-t curves of the In$_2$S$_3$-2h and In$_2$S$_3$/ZnO-100 min NSAs at 1.23 V vs. RHE under chopped AM 1.5G simulated solar illumination.

Table S1 Fitted parameters of the EIS results of the pristine In$_2$S$_3$-2h NSAs, ZnO-100 min film and In$_2$S$_3$/ZnO-100 min NSAs.

<table>
<thead>
<tr>
<th>Sample</th>
<th>$R_s$ (Ω cm$^2$)</th>
<th>$R_{ct}$ (kΩ cm$^2$)</th>
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<tbody>
<tr>
<td>In$_2$S$_3$-2h</td>
<td>16.81</td>
<td>15.95</td>
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<tr>
<td>ZnO-100 min</td>
<td>63.24</td>
<td>224.44</td>
</tr>
<tr>
<td>In$_2$S$_3$/ZnO-100 min</td>
<td>238.7</td>
<td>5.96</td>
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