Electronic Supplementary Information

Synthesis of efficient near-infrared-emitting CuInS$_2$/ZnS quantum dots by inhibiting cation-exchange for bio application

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Fig S1. XPS elemental analysis of Cu, In, S, and Zn for CIS core and CIS/ZnS core/shell QDs.
Fig. S2. The temporal evolution of absorption spectra of CIS/ZnS QDs synthesized at (a) 250°C, (b) 230°C, (c) 210°C, and (d) 180°C, respectively. More blue-shift was observed at 250°C, which is the highest temperature.
Fig. S3. Comparison of the absorption spectra between four samples prepared for with the same duration of ZnS shell synthesis. More blue-shift was observed at 250°C, which is the highest temperature.
Fig. S4 The blue-shifted emission wavelength as a function of synthesis time at relatively low temperature. (a) 210°C and (b) 180°C. Even with long duration time, there is no PL spectra degradation.
Fig. S5 The proposed energy level diagram of Cu-rich CIS-based QDs.
Fig. S6 (a) PL decay curves of CIS and CIS/ZnS QDs measured at 685 and 800 nm. The exponential PL decay components of (b) CIS QDs and (c) CIS/ZnS QDs measured at 685 nm, (d) CIS QDs, (e) CIS/ZnS QDs measured at 800 nm.
Fig. S7 The enhancement of QY as a function of duration of ZnS shell synthesis. The saturated QY of each case is as follows: 180 °C: 28%, 210 °C: 26%, 230 °C: 30%, and 250 °C: 36%
<table>
<thead>
<tr>
<th>Atomic %</th>
<th>Cu</th>
<th>In</th>
<th>S</th>
<th>Zn</th>
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<tbody>
<tr>
<td>CIS core</td>
<td>26.7</td>
<td>21.9</td>
<td>51.4</td>
<td>0</td>
</tr>
<tr>
<td>CIS/ZnS core/shell</td>
<td>7.9</td>
<td>5.2</td>
<td>78.2</td>
<td>8.7</td>
</tr>
</tbody>
</table>

Tab. S1 XPS composition analysis of CIS core and CIS/ZnS core/shell QDs.