Facile synthesis of Cu$_2$PO$_4$OH hierarchical nanostructures and the improved catalytic activity by hydroxyl group †

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<table>
<thead>
<tr>
<th>Chemicals</th>
<th>(^*X(eV))</th>
<th>(E_g(eV))</th>
<th>(E_{VB}(eV))</th>
<th>(E_{CB}(eV))</th>
</tr>
</thead>
<tbody>
<tr>
<td>(\text{Cu}_2\text{PO}_4\text{OH})</td>
<td>6.47</td>
<td>2.82</td>
<td>3.38</td>
<td>0.56</td>
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</tbody>
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*Notes: \(X\), the geometric mean of Mulliken’s electronegativities; \(E_g\), band gap; VBM, valence band maximum; CBM, conduction band minimum.

The positions of conduction and valence bands \((E_{CB}, E_{VB})\) are calculated by Eq. 2 and 3 as follows.

\[
E_{CB} = X - E_e - 0.5E_g \tag{2}
\]
\[
E_{VB} = X - E_e + 0.5E_g \tag{3}
\]

Where \(X\) is the geometric mean of Mulliken’s electronegativities of constituent atoms, \(E_e\) is the energy of free electrons on the hydrogen scale (~4.5 eV), and \(E_g\) is the band gap.
Fig. S1 X-ray diffraction (XRD) patterns of the samples synthesized at different reaction times (a) and temperatures (b).
Fig. S2 (220) diffraction peaks (30–32°) and average crystallite sizes calculated by Scherrer equation of Cu₂PO₄OH obtained at different reaction times (a,c) and temperatures (b,d).
Fig. S3 SEM images of the samples prepared at different reaction times: (a) 12 h; (b) 18 h; (c) 20 h; (d) 24 h; Scale bar = 5 µm.
Fig. S4 SEM images of the samples prepared at different reaction temperatures: (a) 80 °C; (b) 100 °C; (c) 120 °C; (d) 140 °C; Scale bar = 5 µm.
Fig. S5 Effect of catalyst loading on the catalytic degradation of RhB over S-Cu$_2$PO$_4$OH in the presence of H$_2$O$_2$ under UV irradiation ($\lambda \leq 420$ nm).
Fig. S6 Degradation curves (a) and apparent reaction kinetic constants (b) of the samples for the degradation of rhodamine B (RhB) in the presence of H$_2$O$_2$ under UV irradiation ($\lambda$$\leq$420 nm).
Fig. S7 The cycle experiment of S-Cu$_2$PO$_4$OH for the degradation of rhodamine B (RhB) in the presence of H$_2$O$_2$ under UV irradiation.
Fig. S8 Changes of TOC during the degradation of RhB over S-Cu$_2$PO$_4$OH in the presence of H$_2$O$_2$ under UV irradiation (λ≤420 nm).