Supporting Information

High-effective photocatalytic properties and interfacial transfer efficiencies of charge carriers for the novel Ag$_2$CO$_3$/AgX heterojunctions achieved by surface modification

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Fig. S1  High-resolution FESEM images of Ag₂CO₃/AgX (Cl (a), Br(b) and I (c)) samples

Fig. S2  Total XPS spectra of Ag₂CO₃/AgX samples
Fig. S3 Degradation time of RhB over Ag$_2$CO$_3$/AgX samples obtained by adding different volumes of KX solution.

Fig. S4 Dynamic curves of RhB solutions over AgX samples.
Fig. S5 Circle runs of RhB dyes over Ag$_2$CO$_3$ (a) and Ag$_2$CO$_3$/AgX (Cl (b), Br (c) and I (d)) samples.

Fig. S6 N$_2$ adsorption and desorption isotherm of Ag$_2$CO$_3$/AgX (Cl (a), Br (b) and I (c)) samples.
The band positions of AgCl, AgBr, AgI and Ag₂CO₃ can be calculated by the following empirical formulae:

\[ E_{CB} = X - E_c - \frac{1}{2}E_g \]
\[ E_{VB} = E_{CB} + E_g \]

where \( X \) is the absolute electronegativity of the atom semiconductor, expressed as the geometric mean of the absolute electronegativity of the constituent atoms, which is defined as the arithmetic mean of the atomic electron affinity and the first ionization energy; \( E_c \) is the energy of free electrons of the hydrogen scale (4.5 eV); \( E_g \) is the band gap of the semiconductor; \( E_{CB} \) is the conduction band potential and \( E_{VB} \) is the valence band potential. The band gaps of AgCl, AgBr, AgI and Ag₂CO₃ are 3.25 eV \(^1\), 2.60 eV \(^2\), 2.80 eV \(^3\) and 2.46 eV \(^4\), respectively. According to the above equation, the tops of the VB of them are calculated to be 3.31, 2.64, 2.38 and 2.75 eV, as well as the bottoms of the CB of them are calculated to be 0.06, 0.04, -0.42 eV and 0.29 eV, respectively, as shown in Table S1.

<table>
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<tr>
<th>Semiconductor</th>
<th>( X ) (eV)</th>
<th>( E_g ) (eV)</th>
<th>( E_{CB} ) (eV)</th>
<th>( E_{VB} ) (eV)</th>
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<td>AgCl</td>
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<td>0.06</td>
<td>3.31</td>
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<tr>
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<td>2.60</td>
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<td>2.64</td>
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<tr>
<td>AgI</td>
<td>5.48</td>
<td>2.80</td>
<td>-0.42</td>
<td>2.38</td>
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<tr>
<td>Ag₂CO₃</td>
<td>6.02</td>
<td>2.46</td>
<td>0.29</td>
<td>2.75</td>
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</table>

Fig. S7 Dynamic curves (a) and absorbency variations of MB solutions over Ag₂CO₃ and Ag₂CO₃/AgX (X = Cl (b), Br (c) and I (d)) under visible light.
Fig. S8 Dynamic curves (a) and absorbency variations of MO solutions over Ag$_2$CO$_3$ and Ag$_2$CO$_3$/AgX (X = Cl (b), Br (c) and I (d)) under visible light.

Reference