Supporting Information

Toward enhanced photocatalytic activity of graphite carbon nitride through rational design of noble metal-free dual cocatalyst

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Supporting Figures.

Fig. S1. Transmission electron microscopy (TEM) image of the g-C$_3$N$_4$-Ni(OH)$_2$.

Fig. S2. The elemental mapping image of the optimal g-C$_3$N$_4$-MoS$_2$-Ni(OH)$_2$.
Fig. S3 (a) The amount of Mo and Ni, Co, Fe concentrations tested via the ICP and (b) the surface contents of metals via the XPS of the g-C$_3$N$_4$-MoS$_2$, g-C$_3$N$_4$-MoS$_2$-Ni(OH)$_2$ (CMNiOH), g-C$_3$N$_4$-MoS$_2$-Co(OH)$_2$ (CMCoOH), g-C$_3$N$_4$-MoS$_2$-Fe(OH)$_3$ (CMFeOH), respectively.

Fig. S4. (a) Effect of amount of Ni(OH)$_2$ on the UV–visible diffuse reflection spectra in g-C$_3$N$_4$-MoS$_2$-Ni(OH)$_2$. The comparison results of the UV–visible diffuse reflection spectra of g-C$_3$N$_4$, g-C$_3$N$_4$-M(OH)$_x$, g-C$_3$N$_4$-MoS$_2$, and g-C$_3$N$_4$-MoS$_2$-M(OH)$_x$, with M of (b) Ni(OH)$_2$, (c) Co(OH)$_2$ and (d) Fe(OH)$_3$. 

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Fig. S5. The (a) UV–visible diffuse reflection spectra and (b) the band gaps of the g-C₃N₄, g-C₃N₄-MoS₂ with and without Ni(OH)₂.

Fig. S6. The Mott–Schottky plots of (a) Co(OH)₂ and (b) Fe(OH)₃.

Fig. S7. (a) Survey XPS spectrum of the g-C₃N₄-MoS₂-Ni(OH)₂ ternary heterostructure and (b) high-resolution XPS spectra of P 2p. It could be observed that there was no P in the resultant heterostructure sample.
Fig. S8. The photocatalytic hydrogen production rate of the g-C$_3$N$_4$-MoS$_2$ with different amount of MoS$_2$.

Fig. S9. The PL spectra of the g-C$_3$N$_4$-based samples with different amount of Ni(OH)$_2$, (b) MoS$_2$, and (c) types of M(OH)$_x$. The comparison results of the PL spectra of g-C$_3$N$_4$, g-C$_3$N$_4$-MoS$_2$ with and without (d) Fe(OH)$_3$, (e) Co(OH)$_2$ and (f) Ni(OH)$_2$. 

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**Fig. S10.** The transient photocurrent responses of the g-C\textsubscript{3}N\textsubscript{4}-based samples with different amount of Ni(OH)\textsubscript{2}, (b) MoS\textsubscript{2}, and (c) types of M(OH)\textsubscript{x}. The comparison results of the transient photocurrent responses of g-C\textsubscript{3}N\textsubscript{4}, g-C\textsubscript{3}N\textsubscript{4}-MoS\textsubscript{2} with and without (d) Fe(OH)\textsubscript{3}, (e) Co(OH)\textsubscript{2} and (f) Ni(OH)\textsubscript{2}. 
Fig. S11 The high-resolution XPS spectra of (a) C 1s, (b) N 1s, (c) Mo 3d, (d) Ni 2p, (e) Co 2p and (f) Fe 2p of the optimal g-C$_3$N$_4$-MoS$_2$ and g-C$_3$N$_4$-MoS$_2$-M(OH)$_x$ ternary heterostructures.