

## Supplementary Materials

### **Polymeric Carbon Nitride-CNTs-Ferric Oxide All-Solid Z-Scheme Heterojunction with Improved Photocatalytic Activity towards Organic Dye Removal**

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### Synthesis of binary composites (PCN/CNTs, PCN/ $\alpha$ -Fe<sub>2</sub>O<sub>3</sub> and $\alpha$ -Fe<sub>2</sub>O<sub>3</sub>/CNTs)

The synthesis of binary composites was carried out in the same process and conditions as the ternary composites synthesis except for the difference of components. The weight content ratio of PCN, CNTs and  $\alpha$ -Fe<sub>2</sub>O<sub>3</sub> was controlled as follows:  $\alpha$ -Fe<sub>2</sub>O<sub>3</sub> / PCN =1:3, CNTs/PCN=1:10, and CNTs/ $\alpha$ -Fe<sub>2</sub>O<sub>3</sub> =1:10. The binary composites are denoted as PCN/CNTs, PCN/ $\alpha$ -Fe<sub>2</sub>O<sub>3</sub>, and  $\alpha$  Fe<sub>2</sub>O<sub>3</sub>/CNTs.

**Table S1** The calculated reaction rate constants ( $\text{min}^{-1}$ ) for PCN, Fe<sub>2</sub>O<sub>3</sub>, binary composite of PCN/CNTs, PCN/Fe<sub>2</sub>O<sub>3</sub>, and Fe<sub>2</sub>O<sub>3</sub>/CNTs, ternary PCN/CNTs/Fe<sub>2</sub>O<sub>3</sub> hybrids with various CNTs/Fe<sub>2</sub>O<sub>3</sub> mass ratios.

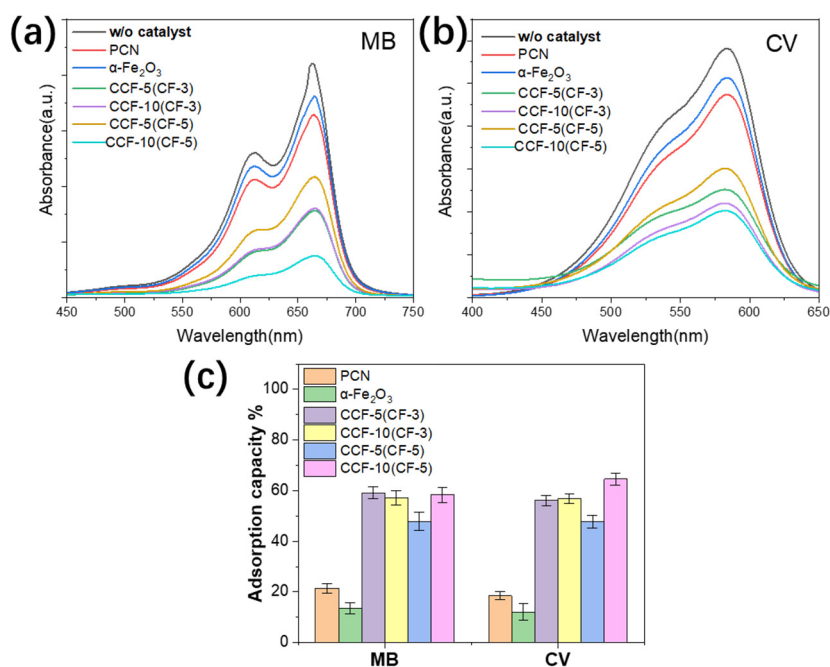
Samples	Kinetic rate constant ( $-k$ , $10^{-3} \text{ min}^{-1}$ )	
	MB	CV
PCN	13.3	12.0
Fe <sub>2</sub> O <sub>3</sub>	3.73	3.24
CCF-5(CF-3)	17.9	36.7
CCF-10(CF-5)	15.9	39.9
CCF-5(CF-5)	19.1	42.4
CCF-10(CF-3)	25.3	56.1
PCN/CNTs	18.8	34.9
PCN/Fe <sub>2</sub> O <sub>3</sub>	15.4	29.1
Fe <sub>2</sub> O <sub>3</sub> /CNTs	2.72	4.23

**Table S2** Physical properties of PCN, Fe<sub>2</sub>O<sub>3</sub> and CCF-10(CF-3)

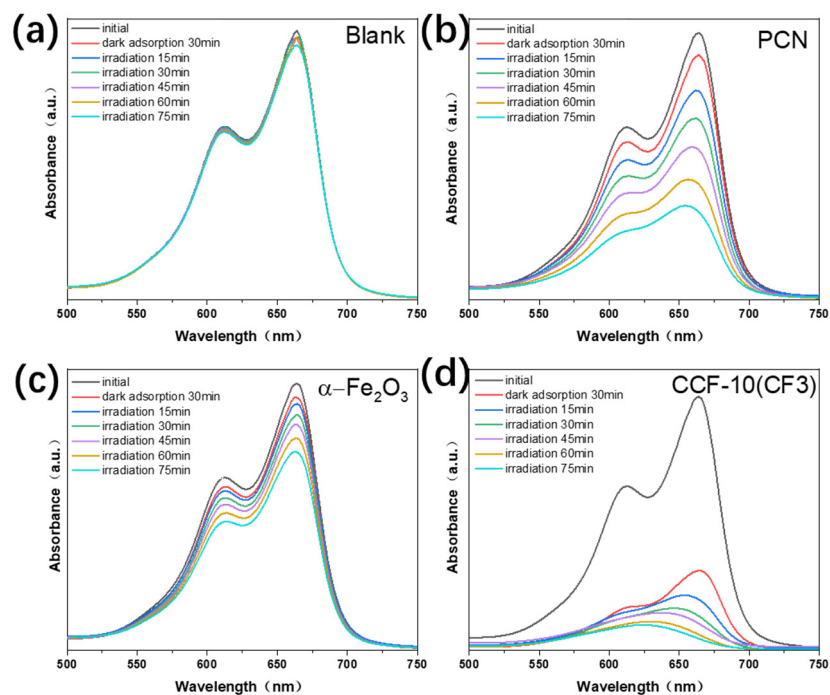
Sample	S <sub>BET</sub> (m <sup>2</sup> /g)	Pore volume (cm <sup>3</sup> /g)	Average pore size (nm)
PCN	11.33	0.027	10.2
$\alpha$ -Fe <sub>2</sub> O <sub>3</sub>	14.54	0.022	8.4
CCF-10(CF-3)	23.34	0.064	12.8

**Table S3** Valence band, conduction band and band gap energies of PCN and  $\alpha$ -Fe<sub>2</sub>O<sub>3</sub> samples.

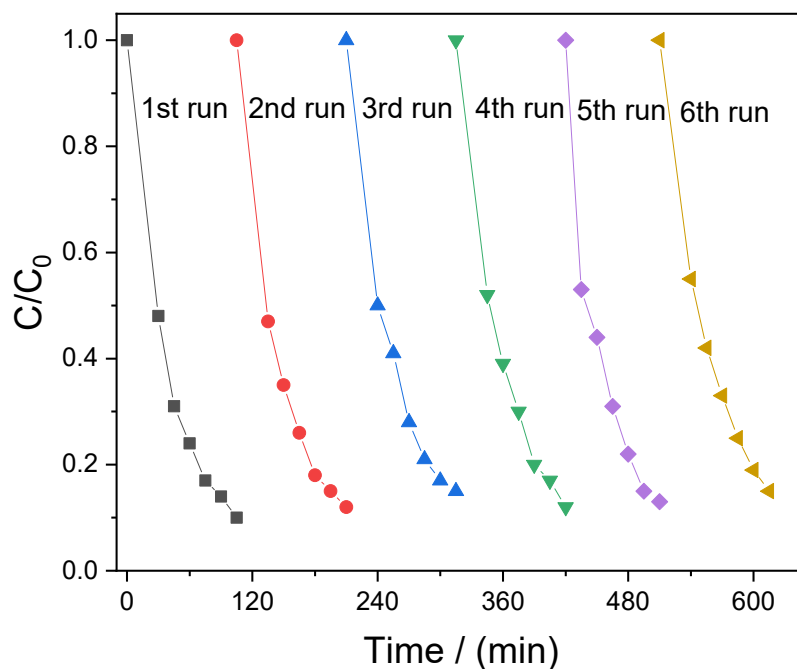
Sample	E <sub>VB</sub> (eV)	E <sub>CB</sub> (eV)	E <sub>g</sub> (eV)
PCN	1.73	-1.49	3.22
$\alpha$ -Fe <sub>2</sub> O <sub>3</sub>	2.31	0.28	2.03



**Figure S1.** UV-Vis absorbance spectra of (a) MB and (b) CV after 30 min dark adsorption over the different samples. (c) Calculated adsorption capacities of MB and CV over the different samples.



**Figure S2** Time-dependence of the UV-Vis absorption spectra of MB in the presence of different samples under light irradiation: (a) Blank, (b) PCN, (c)  $\text{Fe}_2\text{O}_3$  and (d) CCF-10(CF3)



**Figure S3** Recycling test and reusability of CCF-10(CF3) sample using the MB as target substrate.