Supplementary Material

Fabrication of Mn/P co-doping hollow tubular carbon nitride by one-step hydrothermal-calcining method for photocatalytic degradation of organic pollutants

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The control experiment:

(1) Different 3Mn-PCN samples were prepared at different water heat treatment temperatures (160,180 and 200°C) for 6 h.

(2) Different 3Mn-PCN samples were made at 180°C by different water thermal treatment times (4 h, 6 h and 8 h).

(3) 2 g melamine, 2 mL H_3PO_4 and 50 mL deionized water were mixed and stirred for 6h, followed by centrifuging (4000 r), washing with ethanol absolute and deionized water, drying in 60°C oven, and calcining for 4 h in 550°C. Then, we obtained white powder, labeling it as PCN*, which was prepared in the same material proportion as PCN but without hydrothermal process.

The influence of hydrothermal treatment temperature on the photocatalytic performance of Mn-PCN is analyzed (**Fig. S1a**). When the temperature is 160°C, Mn-PCN is not hollow morphology (**Fig. S2a**). Moreover, Mn-PCN tubular breaks when the temperature is 200°C (**Fig. S2b**), then the adsorption capacity strengthens, but the photocatalytic performance decreased. Therefore, the photocatalytic performance of Mn-PCN in a suitable temperature(180°C) is the best. The influence of hydrothermal treatment time on the photocatalytic performance of Mn-PCN was explored (**Fig. S1b**). When the time is 4 h, some parts of Mn-PCN are not yet hexagonal tubular (**Fig. S3a**). Furthermore, the tubular surface structure exist large holes after hydrothermal treatment for 8 h (**Fig. S3b**), which is not conducive to the surface material transfer. The results displays that 6 h is the most appropriate time for hydrothermal treatment. Therefore, the samples prepared under 180°C for 6 h were selected for characterization and further exploration in manuscript.

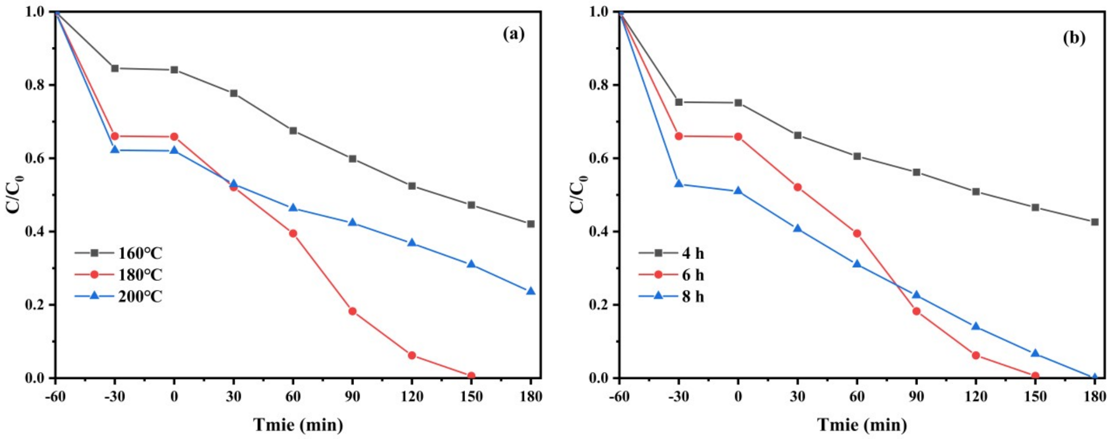

Fig. S1. Effect of hydrothermal treatment (a) temperature and (b) time on photocatalytic degradation of RhB by Mn-PCN.

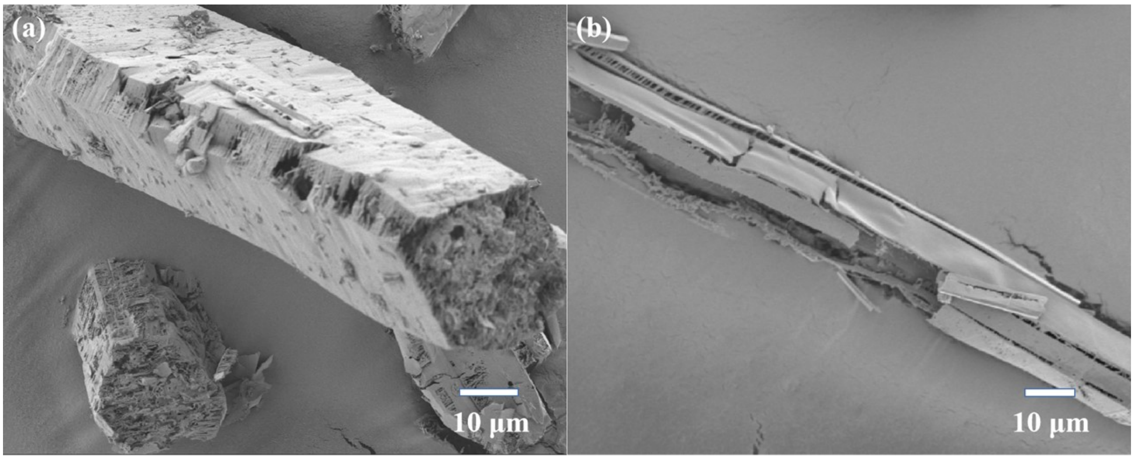

Fig. S2. SEM images of Mn-PCN prepared by hydrothermal treatment in (a) 160°C and (b) 200°C

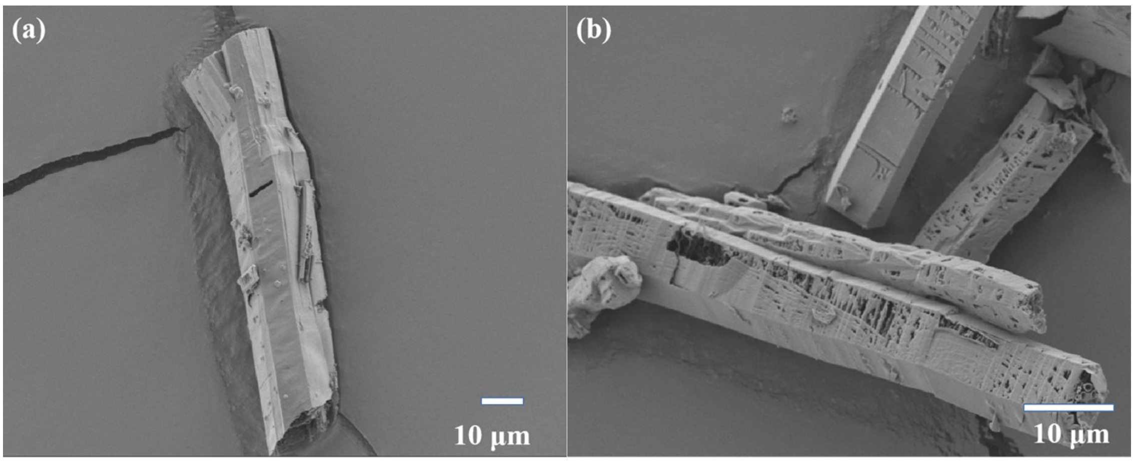

Fig. S3. SEM images of Mn-PCN prepared by hydrothermal treatment for (a) 4 h and (b) 8 h

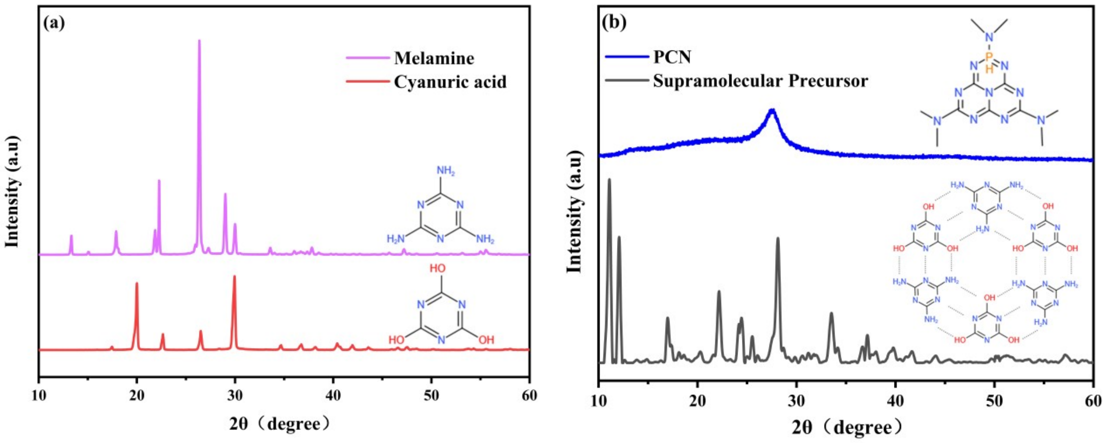

Fig. S4. XRD patterns of (a) melamine and cyanuric acid, (b) PCN precursor and PCN

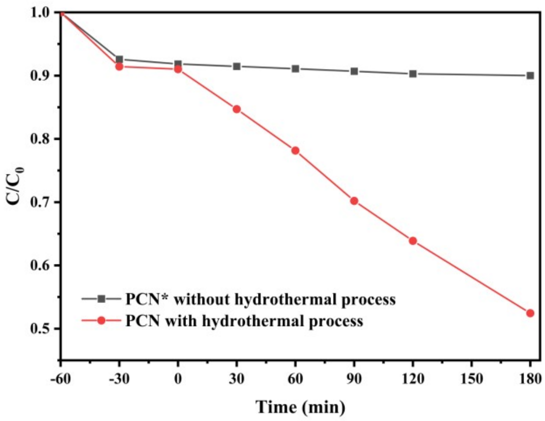

Fig. S5. the comparison of the photocatalytic properties of PCN and PCN*

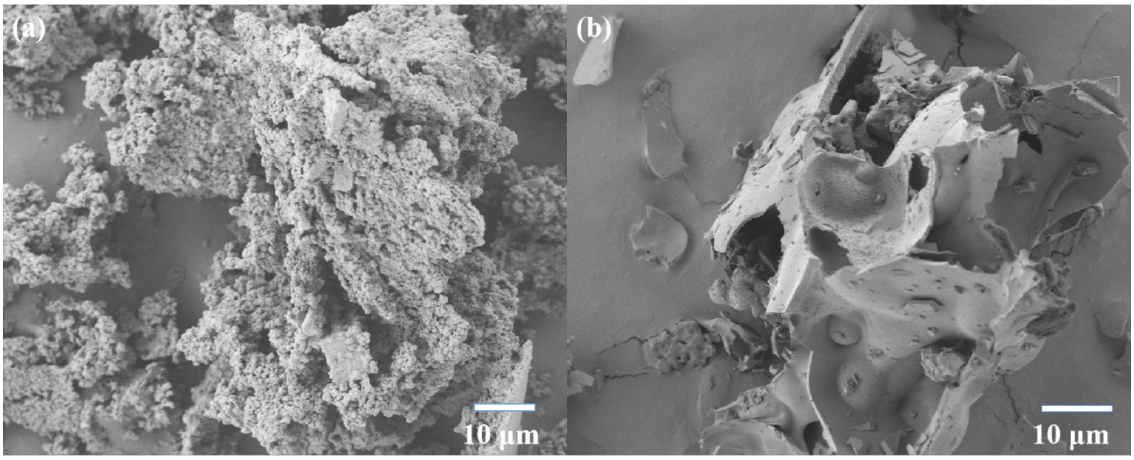

Fig. S6. SEM images of (a) precursor of PCN*, and (b) PCN*

In Fig. S7, it can be clearly seen that the acidity and alkalinity of RhB solution exerts no significant influence on degradation rate, suggesting that the 3Mn-PCN is effective for degrade at a wide pH range, which implies that it is feasible over Mn-PCN for the treatment of organic contaminates.

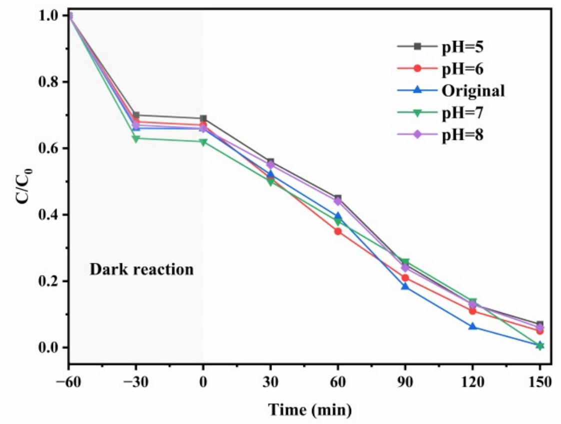

Fig. S7 The effect of solution pH on the degradation kinetics for RhB with 3Mn-PCN