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Enhanced photocatalytic performance of S-doped covalent triazine framework for organic pollutant degradation

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Innovation

- Using Mo and BPA as representative pollutants of dyes and PPCPs as probes, the photocatalytic ability of the materials and effects of hydroxyl functional groups in pollutant molecules were examined to achieve efficient removal of organic pollutants from water and recycling of photocatalysts.

- Probing the photocatalytic mechanism in terms of both reactive oxygen species (ROS) and material properties not only provides a targeted strategy for solving the challenge of low concentration organic pollutant removal from water, but also provides a feasible and effective solution for developing the design of metal-free catalysts with enhanced visible light collection and charge separation.

Characterizations: morphology

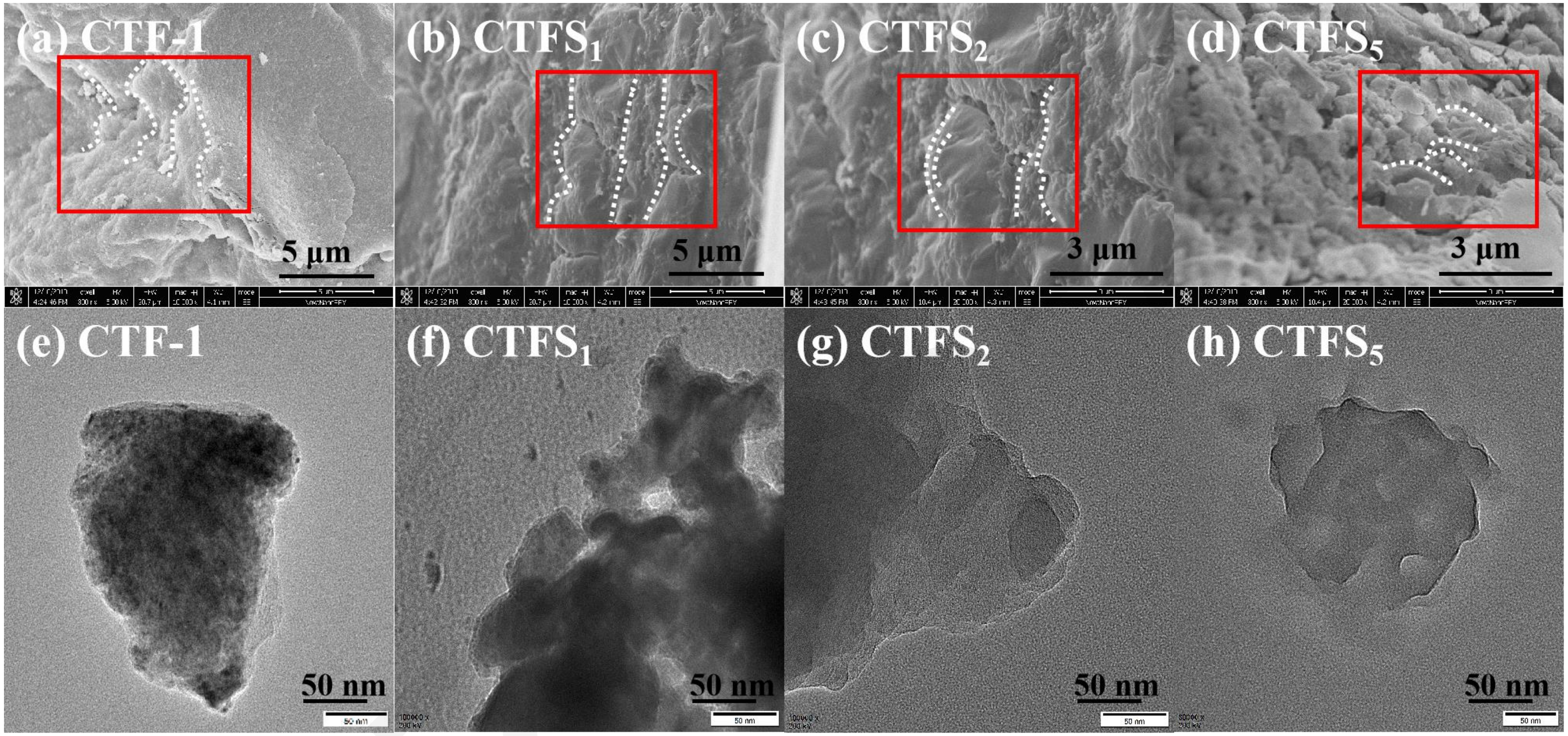

Fig. 1. SEM images of CTF-1 (a), $CTFS_1$ (b), $CTFS_2$ (c) and $CTFS_5$ (d); TEM images of CTF-1 (e), $CTFS_1$ (f), $CTFS_2$ (g) and $CTFS_5$ (h)

The nanosheet morphology facilitated the transfer of electrons in the layer, while the S doping leads to the breakage of the otherwise uniform molecular dipole moment of the CTF and delays the recombination of photogenerated electrons and holes.

Photocatalytic performance

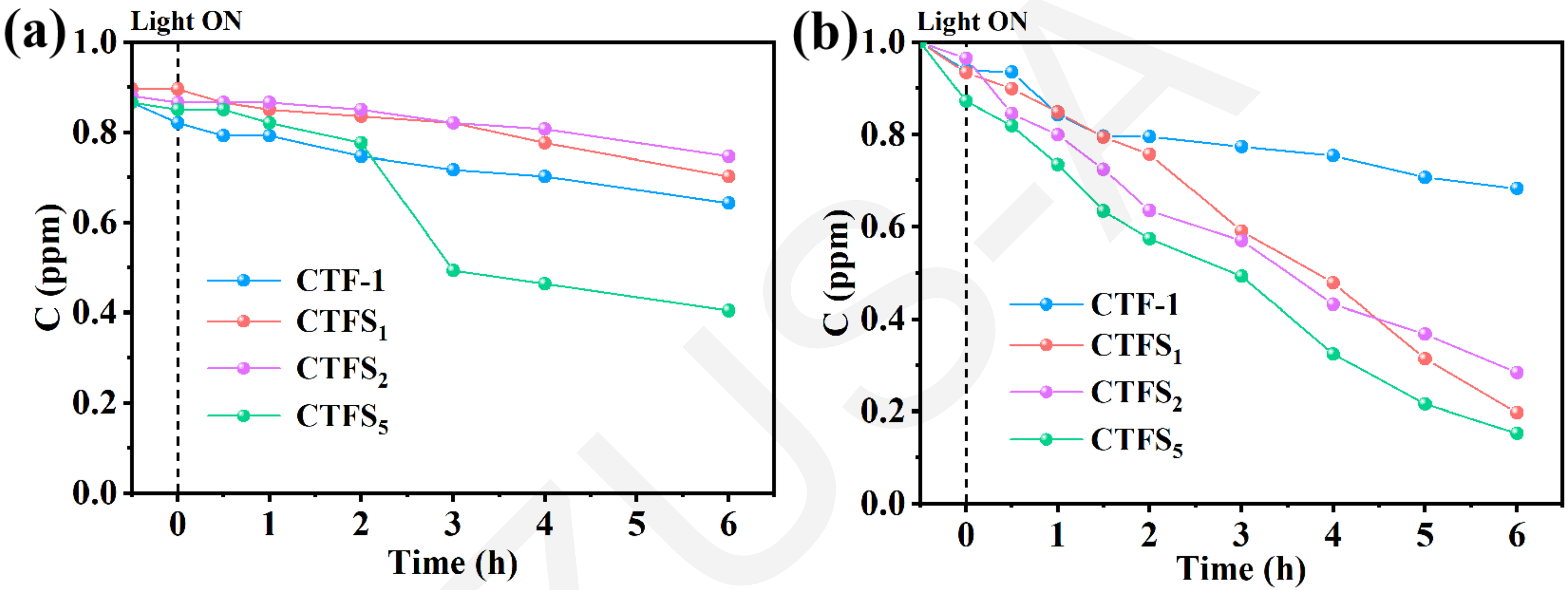

Fig. 4. Removal efficiency of MO (a) and BPA (b) by CTFs before and after visible light irradiation

The photocatalytic degradation of MO and BPA by CTFSx was superior to that by CTF-1. $CTFS_5$ exhibited the best photocatalytic performance, within 6 h of visible light catalytic reaction, 53.2% MO and 84.7% BPA were degraded.

Photocatalytic performance

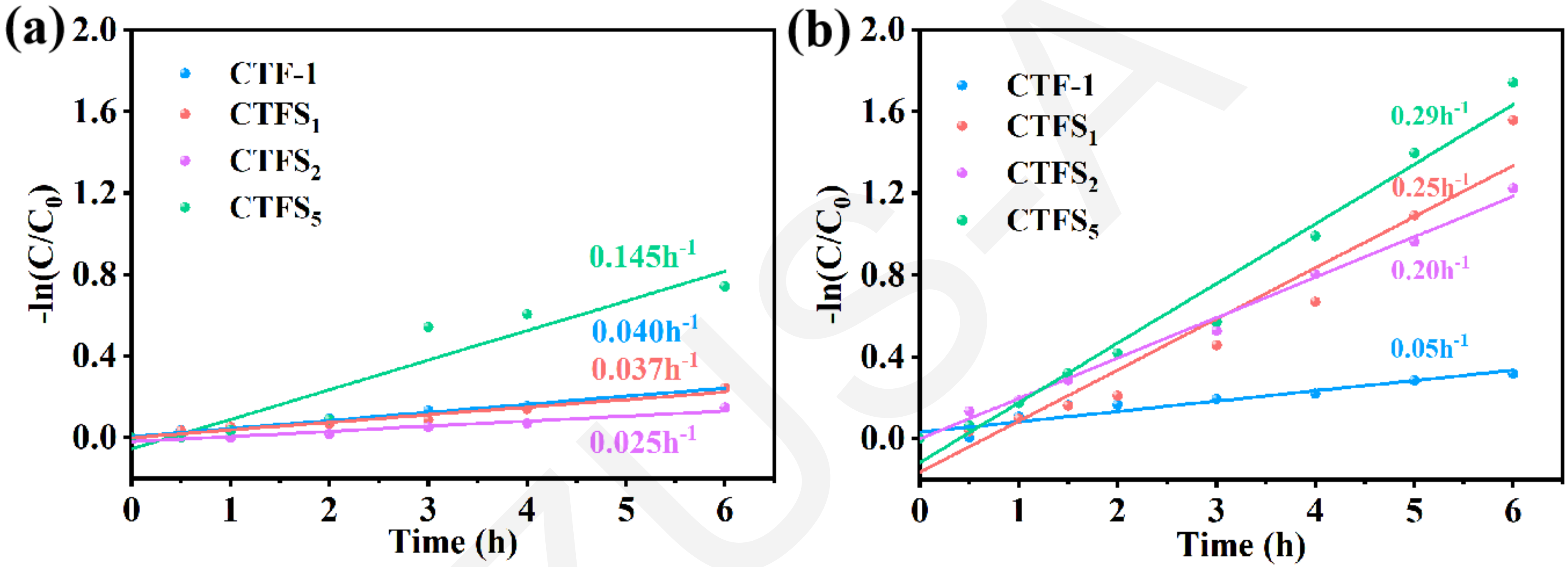

Fig. 5. First-order kinetic fitting of CTF-1 and CTFSx on photocatalytic degradation of MO (a) and BPA (b)

$CTFS_5$ maintained the highest degradation rates of MO (0.145 h^{-1}) and BPA (0.29 h^{-1}). They were 3.6 times and 5.8 times higher than those of CTF-1, which were comparable to photocatalytic activity.

Photocatalytic mechanism

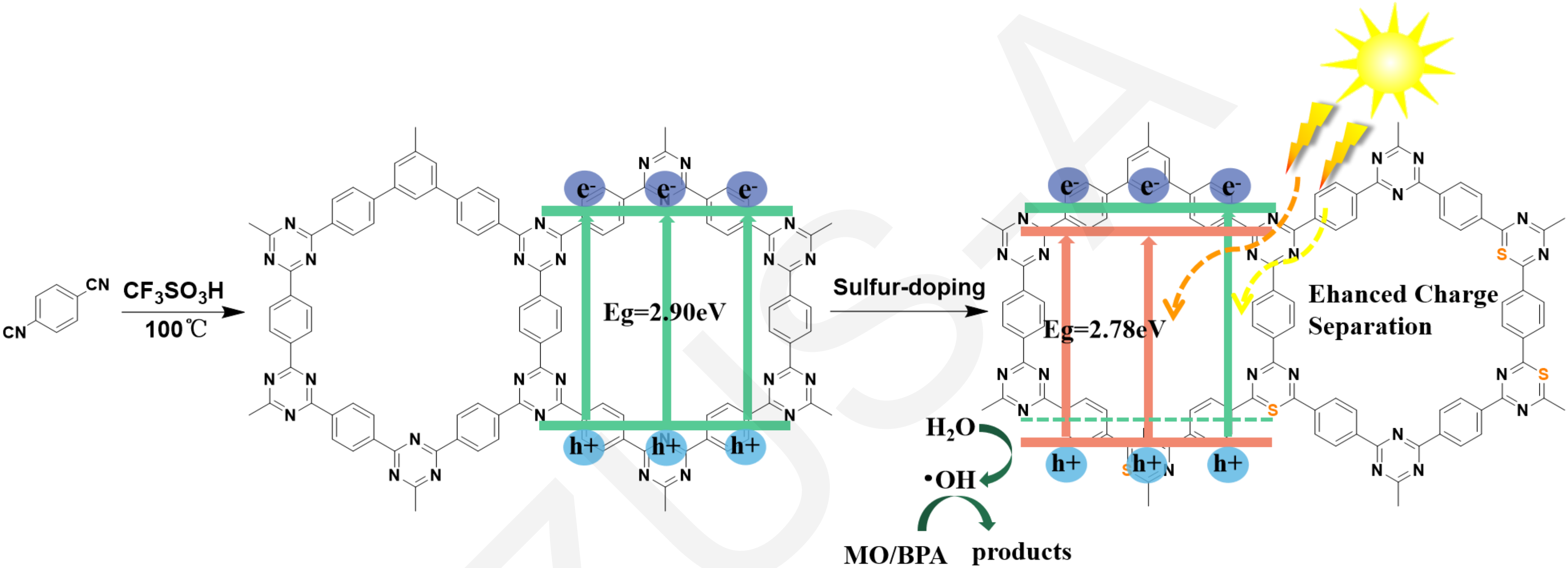

Fig. 8. Removal mechanism diagram of MO/BPA by CTFSx

Doping S in CTF-1 could enhance the absorption of visible light and reduce the degree of free carrier recombination. This promoted the rapid separation and transfer of photogenerated electrons and holes, further enhancing the oxidative ability of •OH, and finally improving the photocatalytic efficiency.

Conclusions

- The photocatalytic degradation of MO and BPA by CTFSx was superior to that by CTF-1, with better stability and reusability. Within 6 h, 53.2% MO and 84.7% BPA were degraded by $CTFS_5$, and the reaction rate constants (k) were 0.145 h^{-1} and 0.29 h^{-1}, respectively, which were 3.6 and 5.8 times higher than those of CTF-1.

- •OH was mainly involved in the degradation of organic pollutants to carbon dioxide and water.

- The enhanced visible light absorption, narrowed band gap, corrected VB position, and faster photogenerated charge transfer were the main reasons for the markedly improved photocatalytic activity of $CTFS_5$.