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Tailored Graphitic Carbon Nitride–Biochar Composites for Enhanced Photodegradation of Recalcitrant Pharmaceuticals

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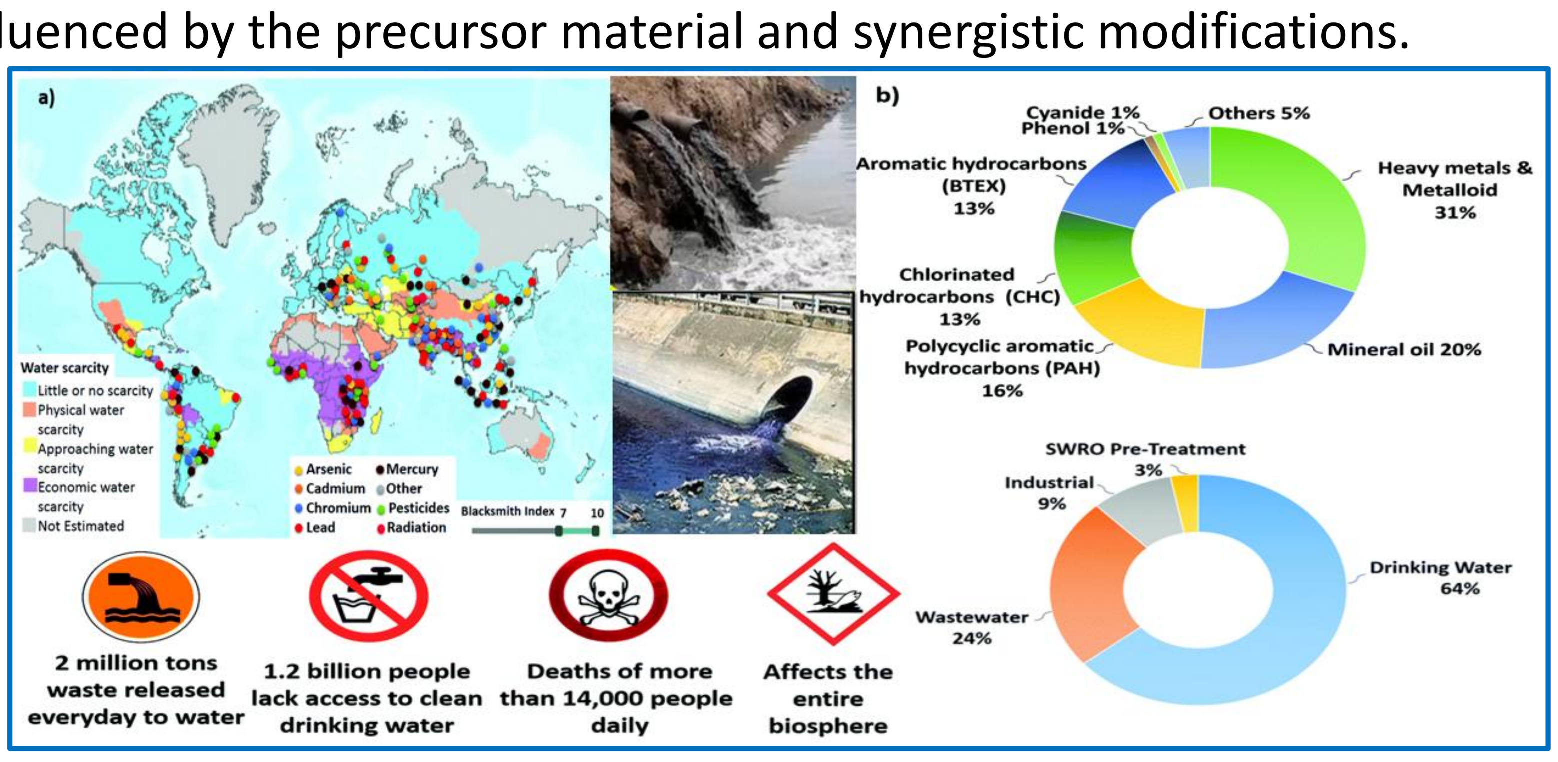
INTRODUCTION

Recent environmental assessments have highlighted the urgent need for efficient and sustainable technologies capable of degrading recalcitrant pharmaceutical pollutants in freshwater systems. Among photocatalytic materials, graphitic carbon nitride (g-C_3N_4) has garnered attention due to its visible light activity, chemical stability, and tunable properties. However, its performance is strongly influenced by the precursor material and synergistic modifications.



AIM

This study investigates the photocatalytic performance of g-C_3N_4 derived from melamine, urea, and thiourea, and the enhancement achieved through blending with biochar for pharmaceutical pollutant degradation.

METHOD

Fig. 1 Catalyst Synthesis from three different sources

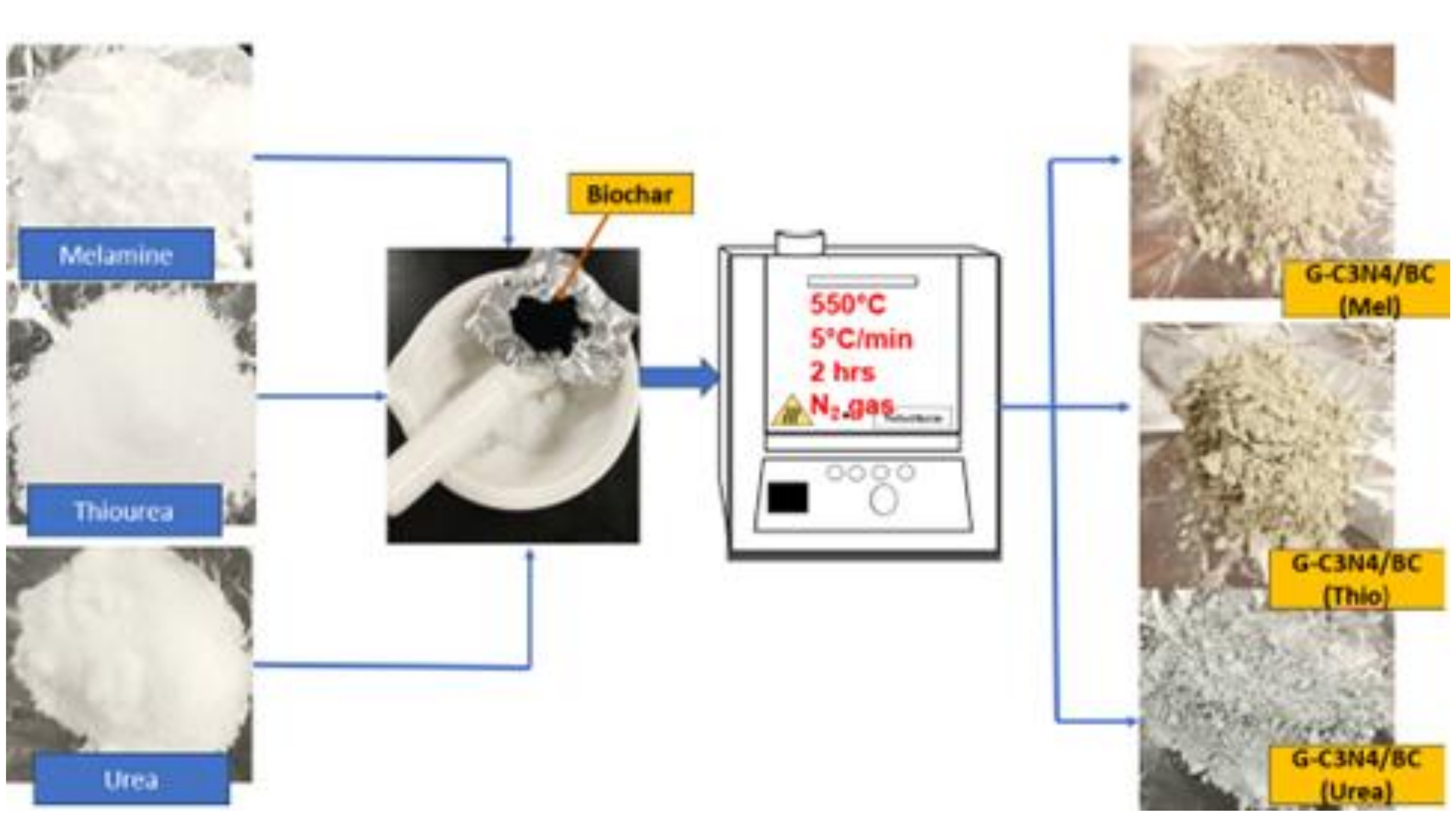


Fig.2 Catalyst Synthesis with biochar blend

RESULTS & DISCUSSION

Among the pure g-C_3N_4 sources, urea showed the highest methyl orange degradation at 60.25%, followed by thiourea (32.05%) and melamine (7.59%). Combining urea with melamine and thiourea enhanced photocatalytic activity. Urea-based g-C_3N_4 with biochar achieved **59.7%** degradation of methyl orange and efficiencies of **92.59%, 84.44%, 68.11%,** and **61.11%** for tetracycline, cefixime, ciprofloxacin, and carbamazepine, respectively.

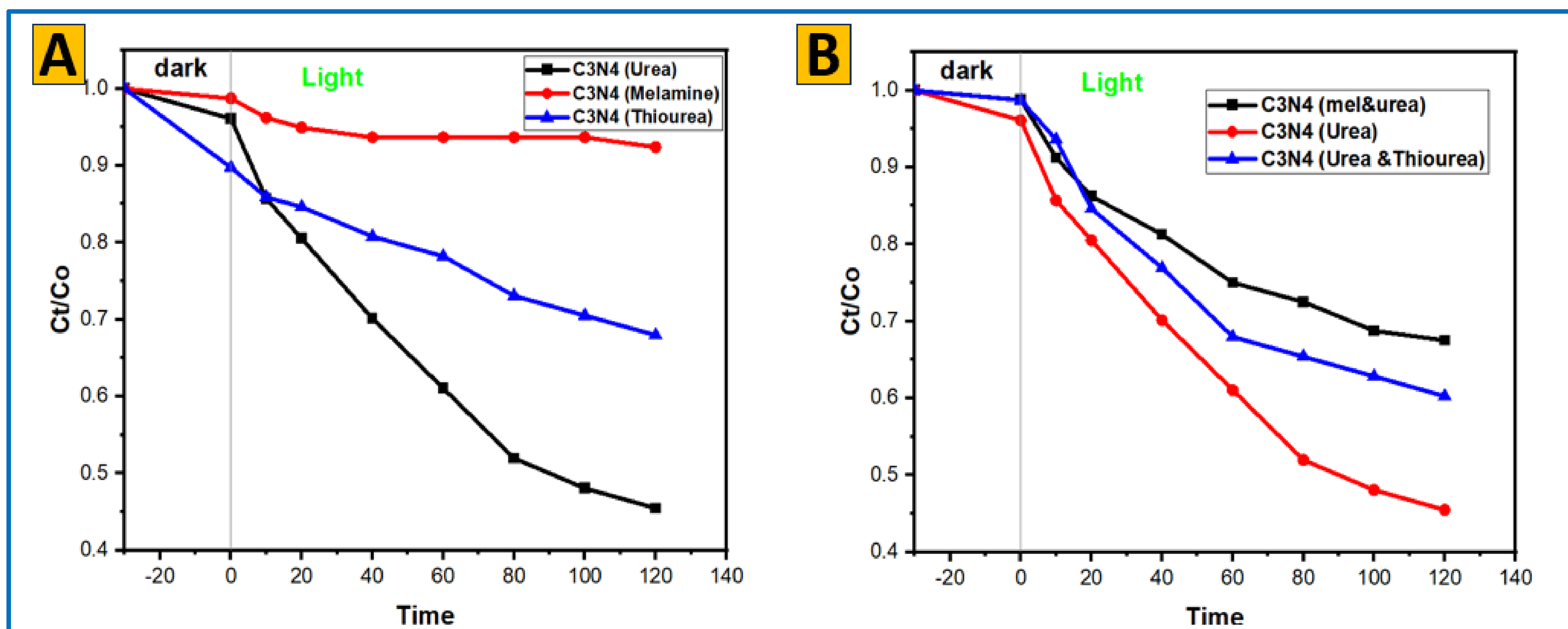


Fig.3 Degradation efficiency of MO using (a) single source and (b) urea-blend

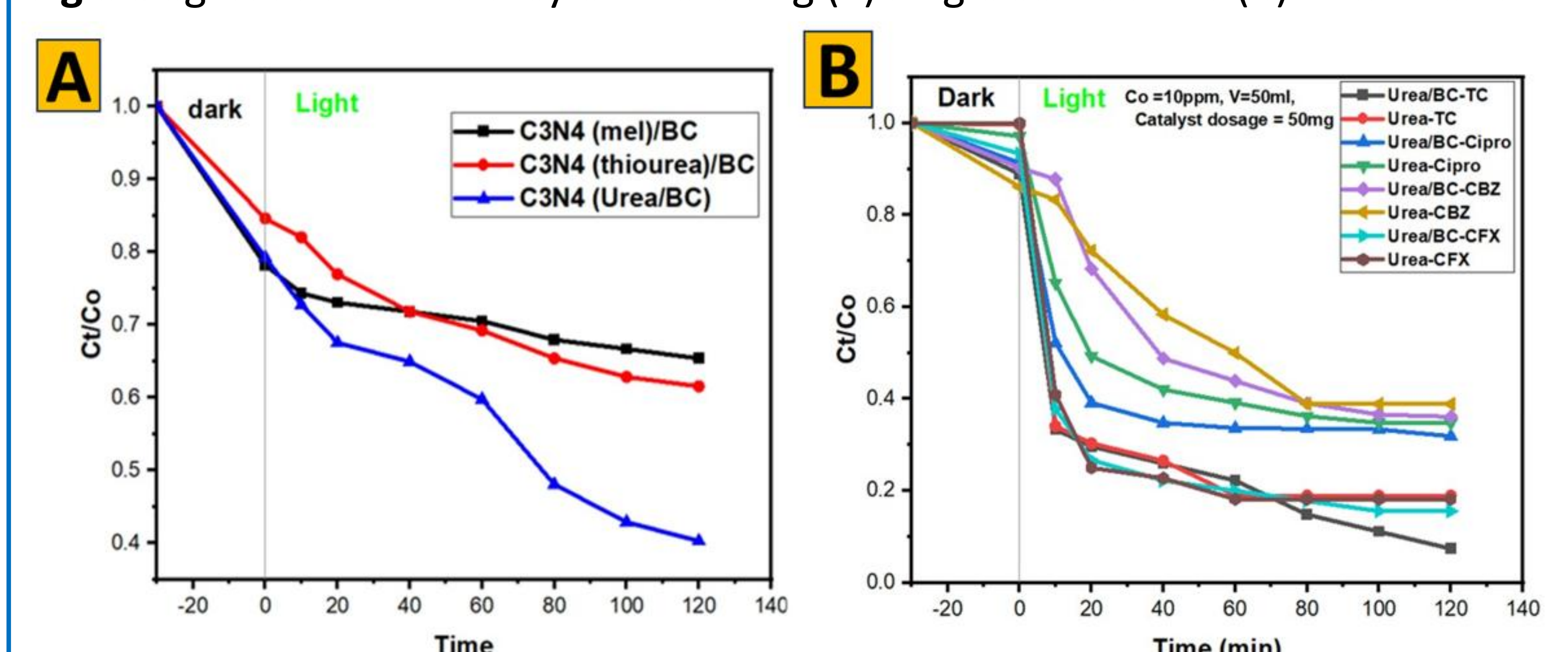


Fig.4 Degradation efficiency of (a) Methyl orange (b) Pharmaceuticals

These results highlight biochar's synergistic role in improving charge separation and providing more adsorption sites.

CONCLUSION

Urea-derived g-C_3N_4 showed superior photocatalytic performance, while biochar enhanced adsorption and degradation of pharmaceutical pollutants. This composite material holds promise for sustainable water treatment, particularly for persistent pharmaceutical residues.

FUTURE WORK

Future work will optimize composite ratios, explore visible-light-active dopants, and test real wastewater samples. References will include recent studies on g-C_3N_4–biochar composites and pharmaceutical degradation.

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