IOCXe 2026 Conference

The 1st International Online Conference on Xenobiotics

22–23 June 2026 | Online

MDPI

Advanced Doped and Composite Graphitic Carbon Nitride Photocatalysts for Efficient Degradation of Organic Pollutants under Visible Light

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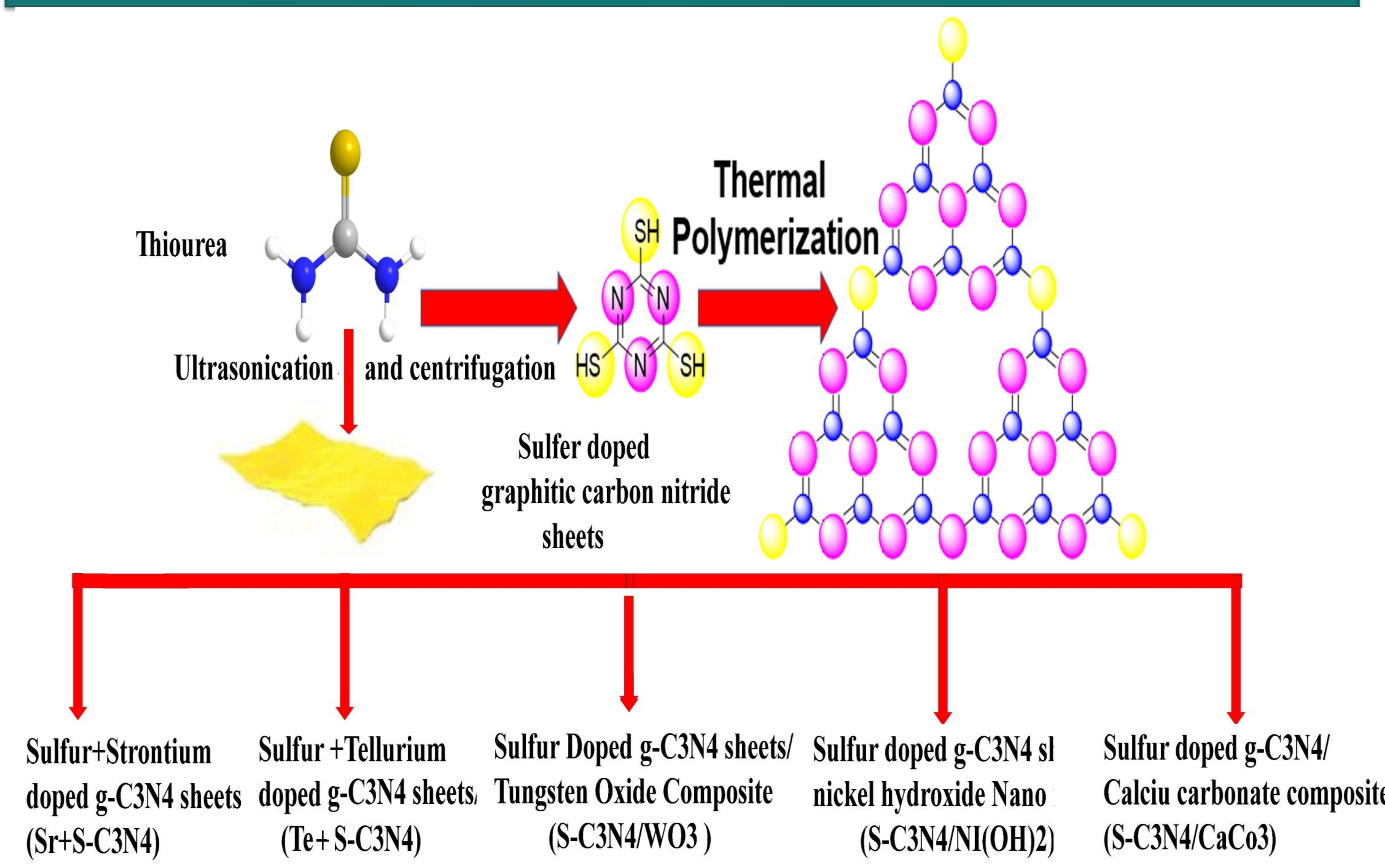
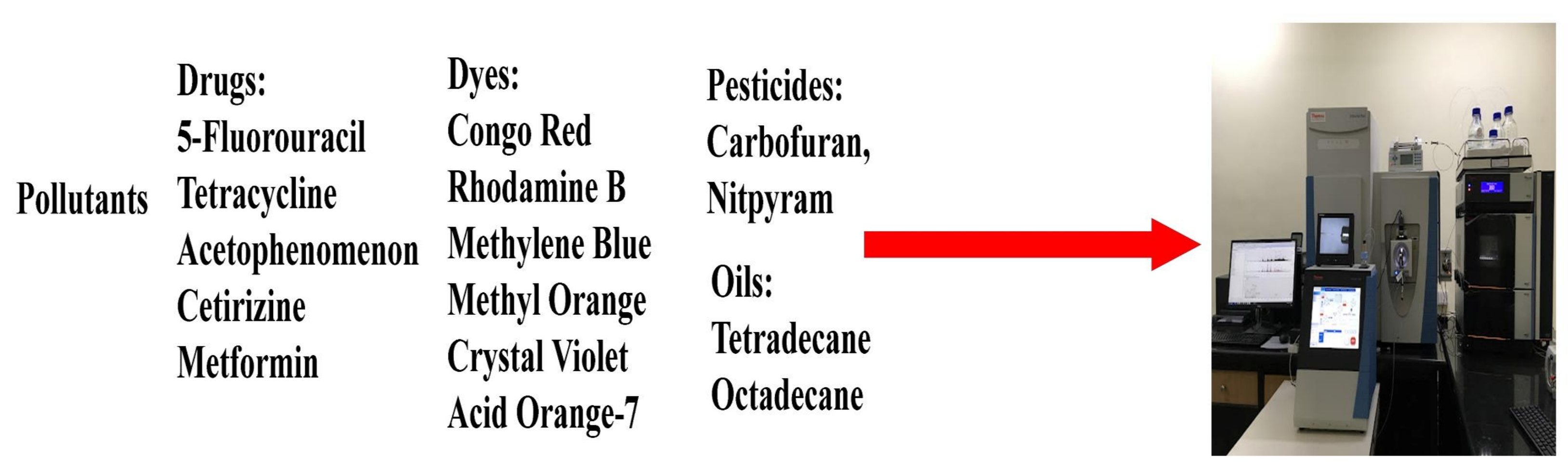
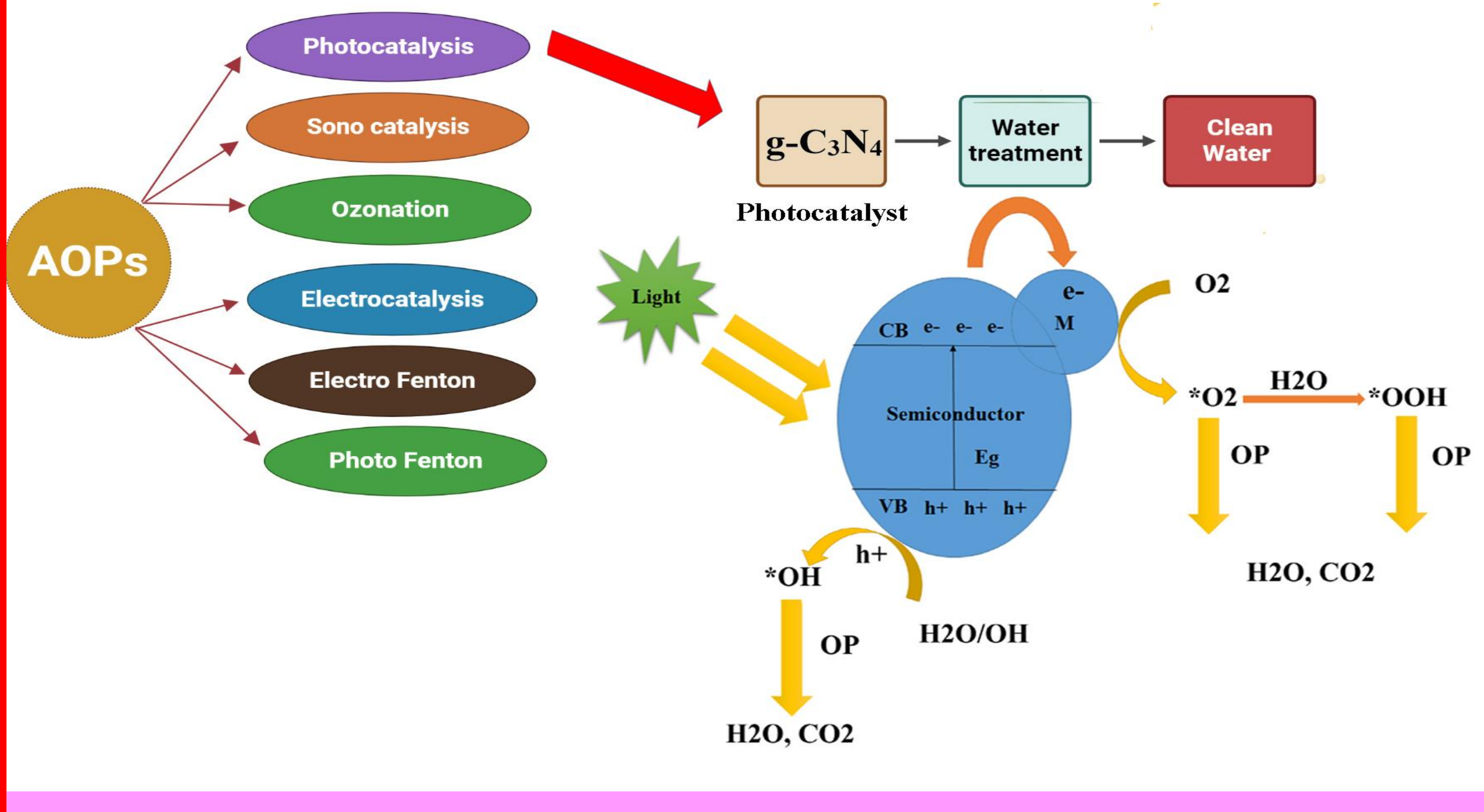
INTRODUCTION & AIM

This work presents the design, synthesis, and application of advanced doped and composite graphitic carbon nitride (g-C_3N_4)-based photocatalysts for the efficient degradation of diverse organic pollutants under visible light. Sulfur, yttrium-, tellurium-, and strontium-doped g-C_3N_4, as well as 2D Z-scheme S-g-C_3N_4/WO_3 composites, were synthesized using facile thermal polymerization, two-step pyrolysis, one-pot calcination, and wet-impregnation methods. These materials exhibited significantly enhanced photocatalytic performance compared to pristine g-C_3N_4, achieving up to 99% degradation of industrial dyes such as methylene blue, acid orange 7, and congo red, as well as pharmaceutical contaminants including acetaminophen and 5-fluorouracil. The reaction kinetics followed pseudo-first-order models, with substantially higher rate constants and shorter half-lives for the doped and composite catalysts. Mechanistic studies, supported by radical scavenger tests and LC-MS analysis, revealed superoxide radicals and photogenerated holes as the primary active species, with minor contributions from hydroxyl radicals and electrons. Structural, optical, and electrochemical characterizations confirmed improved charge separation, band gap tuning, and stability of the synthesized photocatalysts. Biocompatibility tests using seeds demonstrated negligible toxicity and potential applicability in environmentally friendly water treatment. These findings underscore the versatility and efficiency of doped and composite g-C_3N_4 photocatalysts for sustainable remediation of various organic pollutants.

METHOD

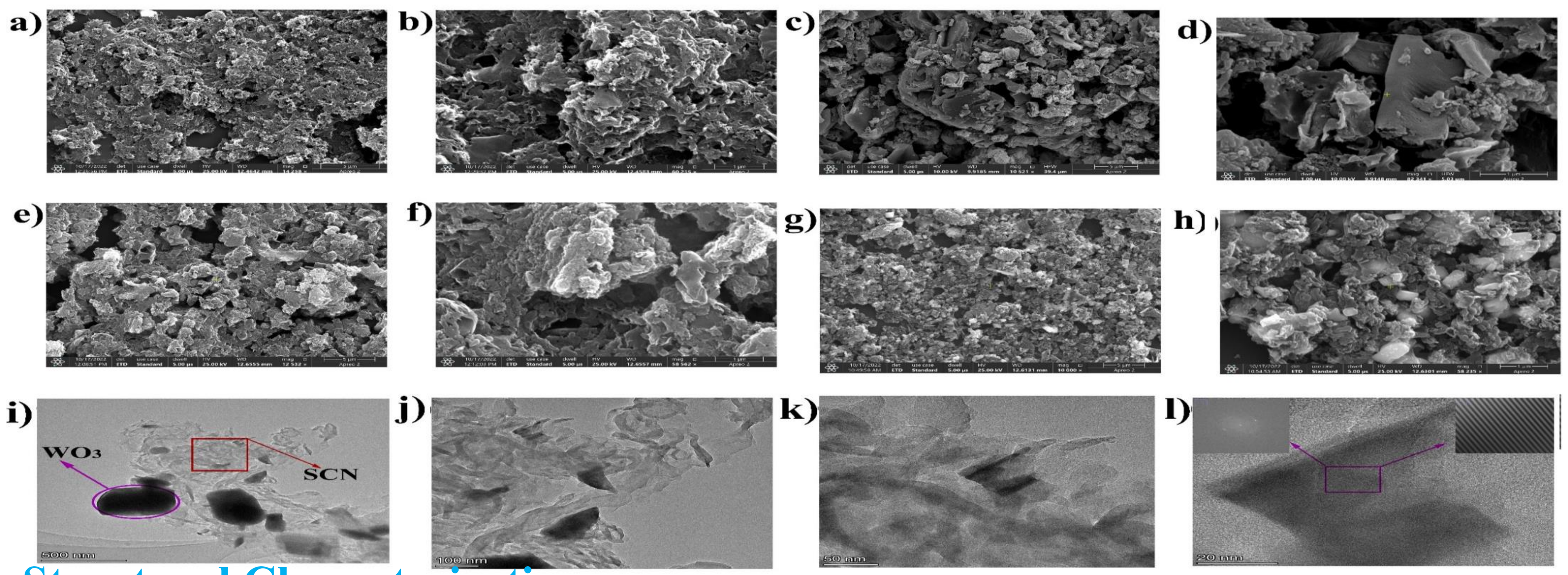




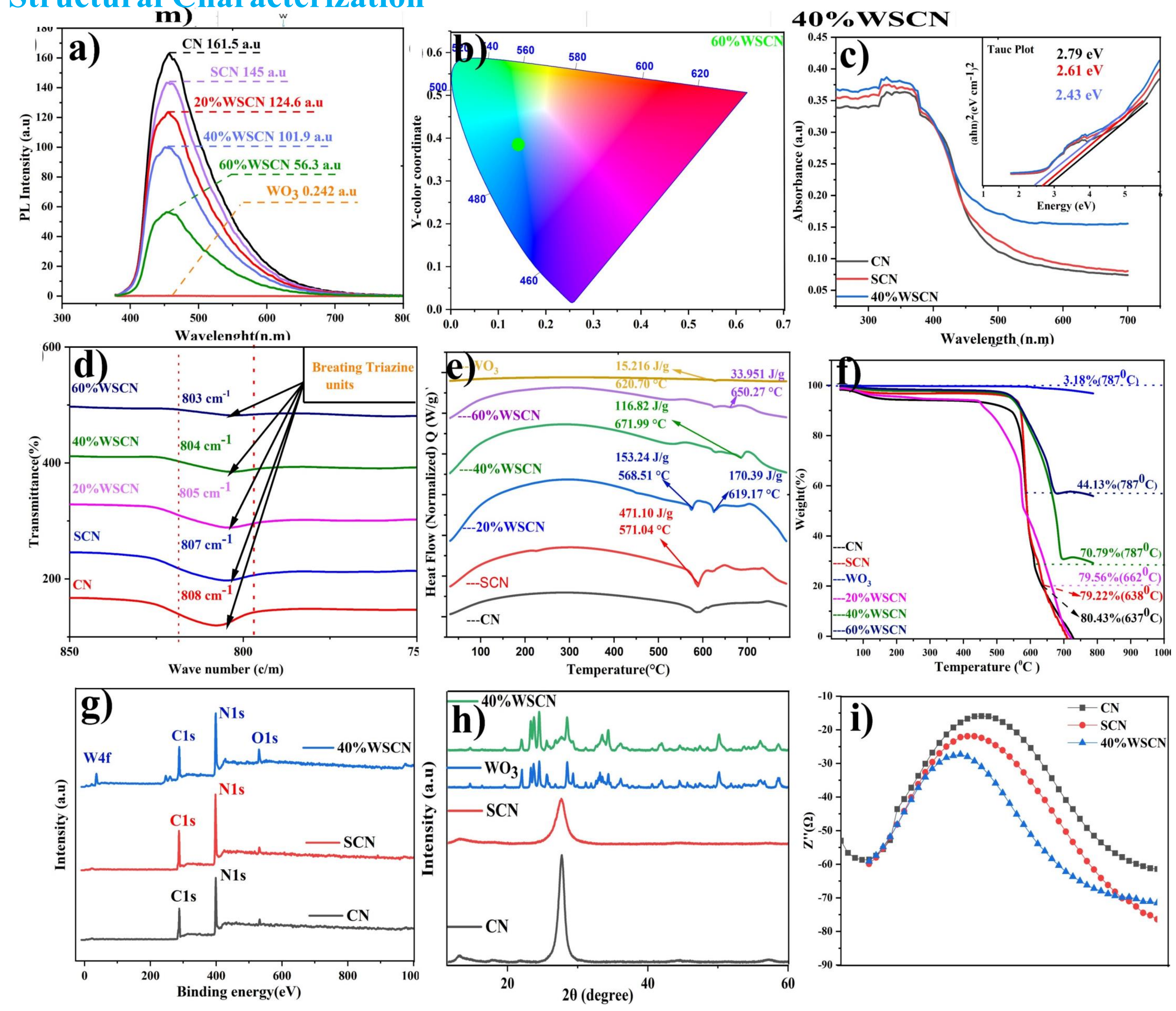


RESULTS & DISCUSSION

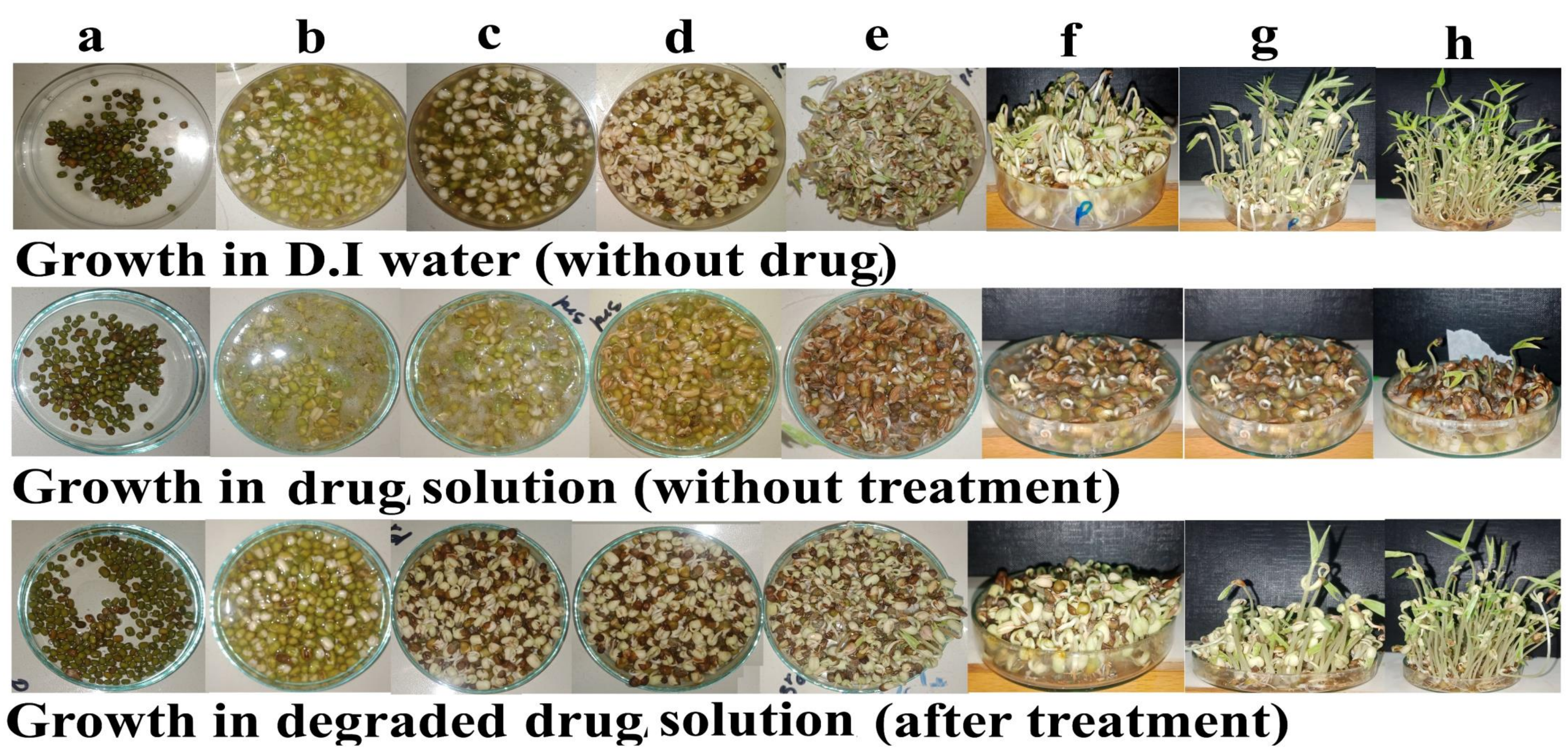
Morphological Characterization



Structural Characterization



Biocompatibility test



CONCLUSION

We synthesized sulfur-doped g-C_3N_4 materials for the detoxification of drugs, dyes, pesticides, and oils, demonstrating high photocatalytic efficiency. Mass spectrometry analysis confirmed effective pollutant degradation, highlighting its potential as a sustainable solution for environmental remediation

FUTURE WORK / REFERENCES

- J. Saththasivam et al., Chemosphere 144 (2016) 671-680.
- N. Zhao et al., J. Waste Manag. 104 (2020) 20-32.