



Sustainable Wastewater Treatment Using Fe and La Co-Doped ZnO: A Photocatalytic Approach

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01. Introduction

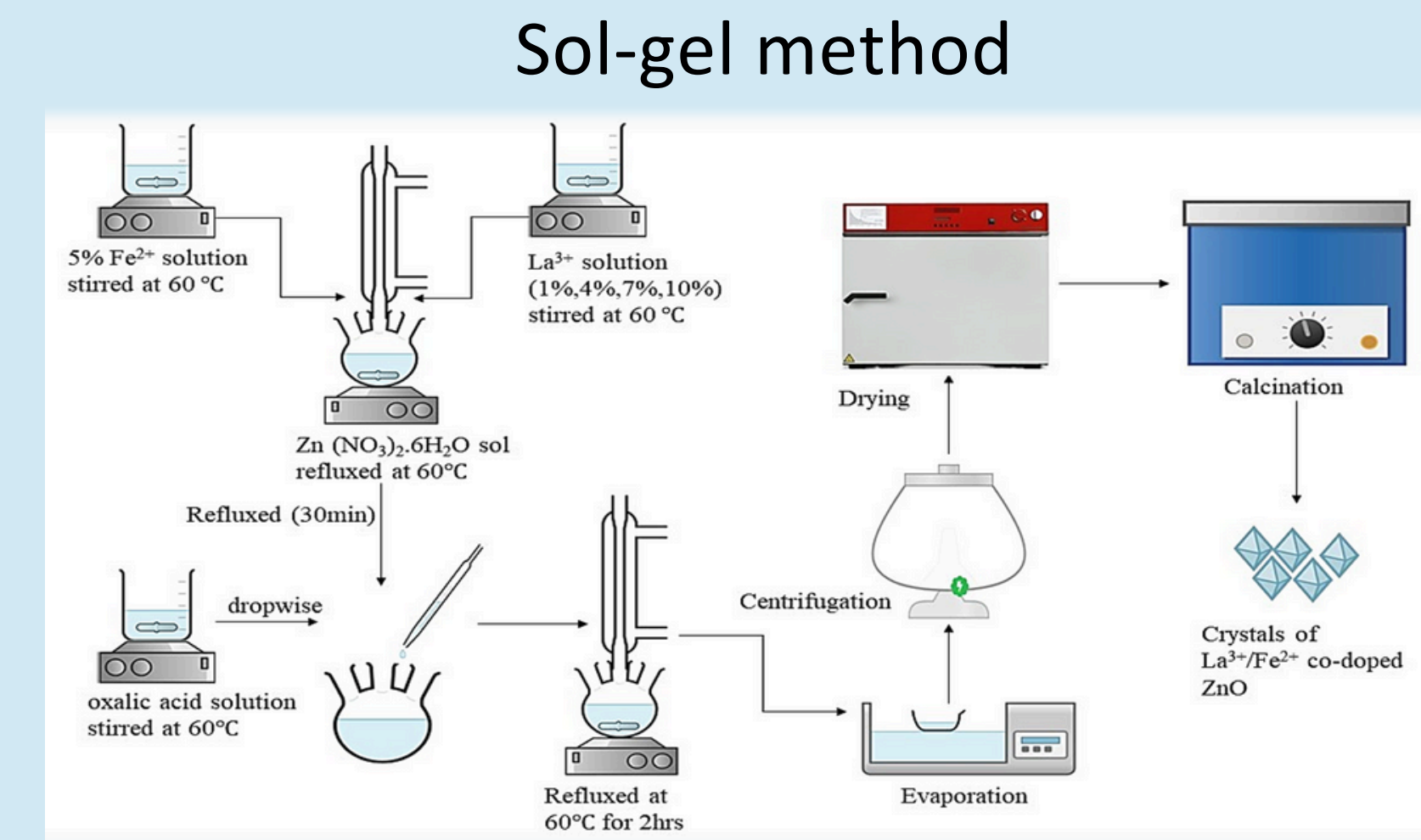
Environmental Challenge: Increasing industrial pollution, especially dye contamination in water bodies, demands innovative and sustainable solutions.

ZnO as a Base Material: Zinc oxide is widely used for its photocatalytic and semiconductor properties, but suffers from limitations like wide band gap and fast recombination of charge carriers.

Role of Doping: Doping ZnO with transition and rare earth metals is a proven strategy to enhance its photocatalytic, magnetic, and electronic behavior.

Our Approach: We co-doped ZnO with Iron (Fe) and Lanthanum (La) to engineer multifunctional nanomaterials for environmental and advanced device applications.

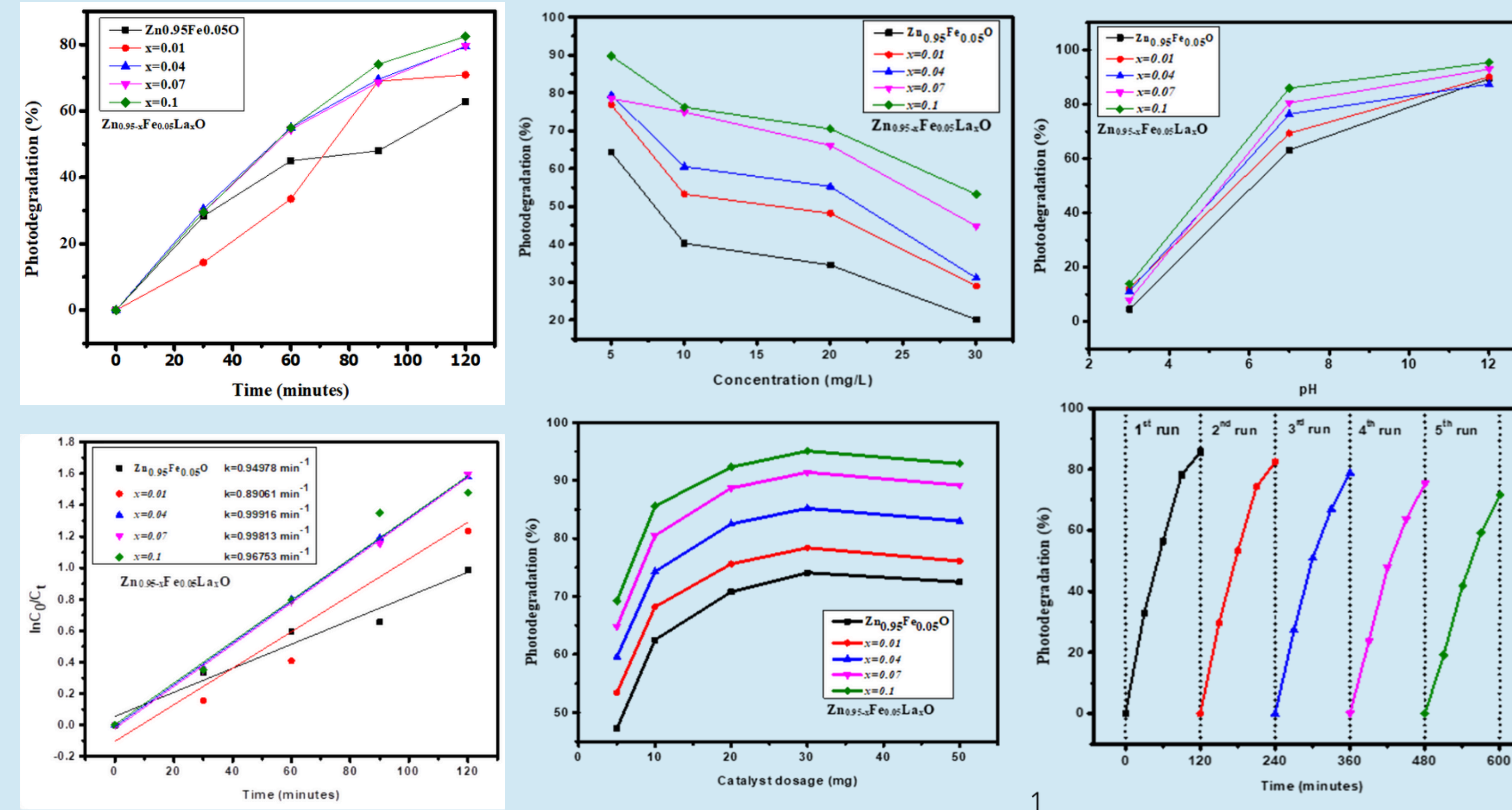
02. Methodology



Relevant SDGs



04. Photocatalysis



05. Results/Findings

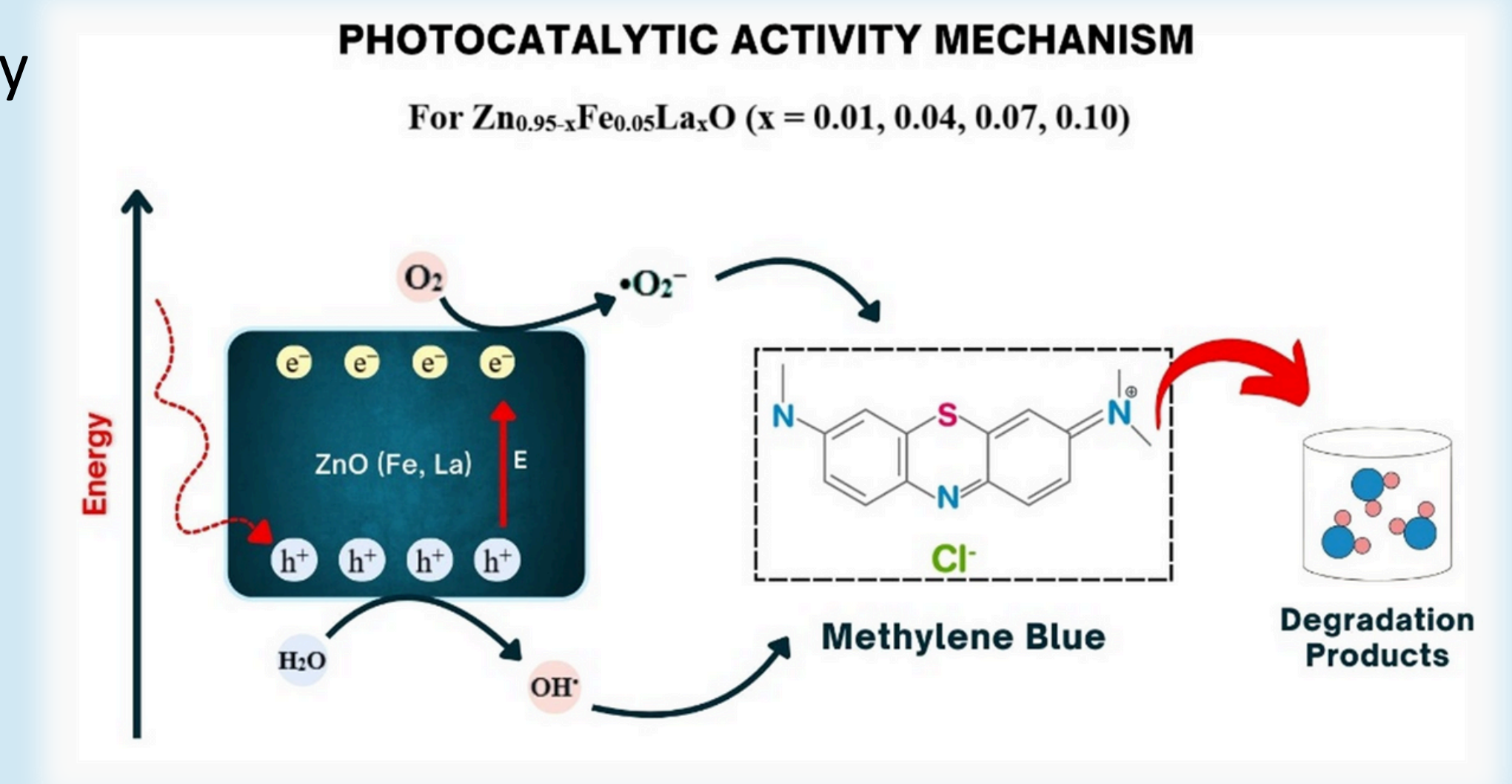
Structural: Successful Fe & La incorporation → lattice distortion, reduced crystallite size.

Optical: Band gap reduced → 3.3 eV (ZnO) → 2.8–3.0 eV (co-doped).

Photocatalysis:

- Pure ZnO: moderate degradation.
- Fe–La ZnO: significantly 82.46% degradation efficiency, optimal at certain dopant concentration.

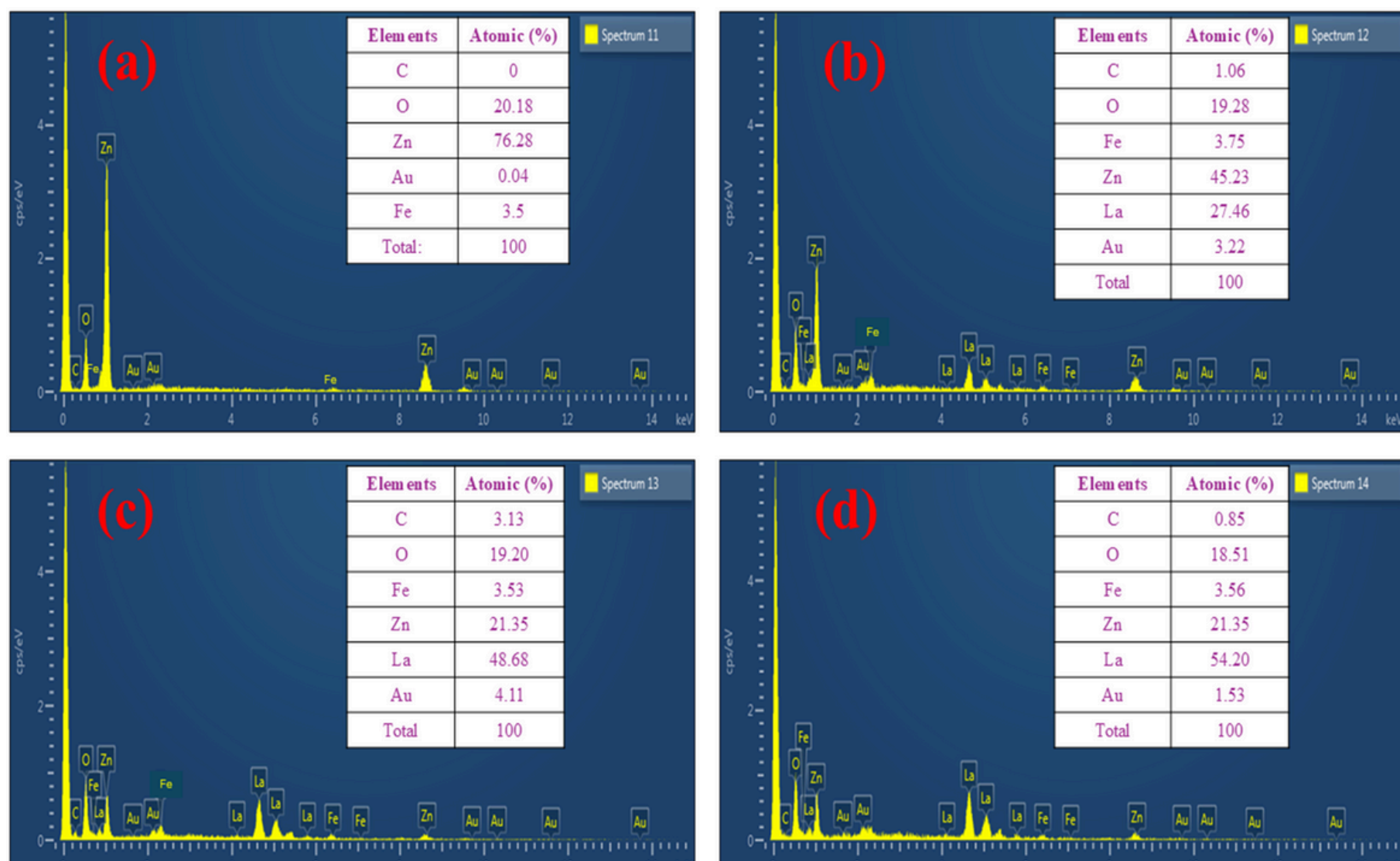
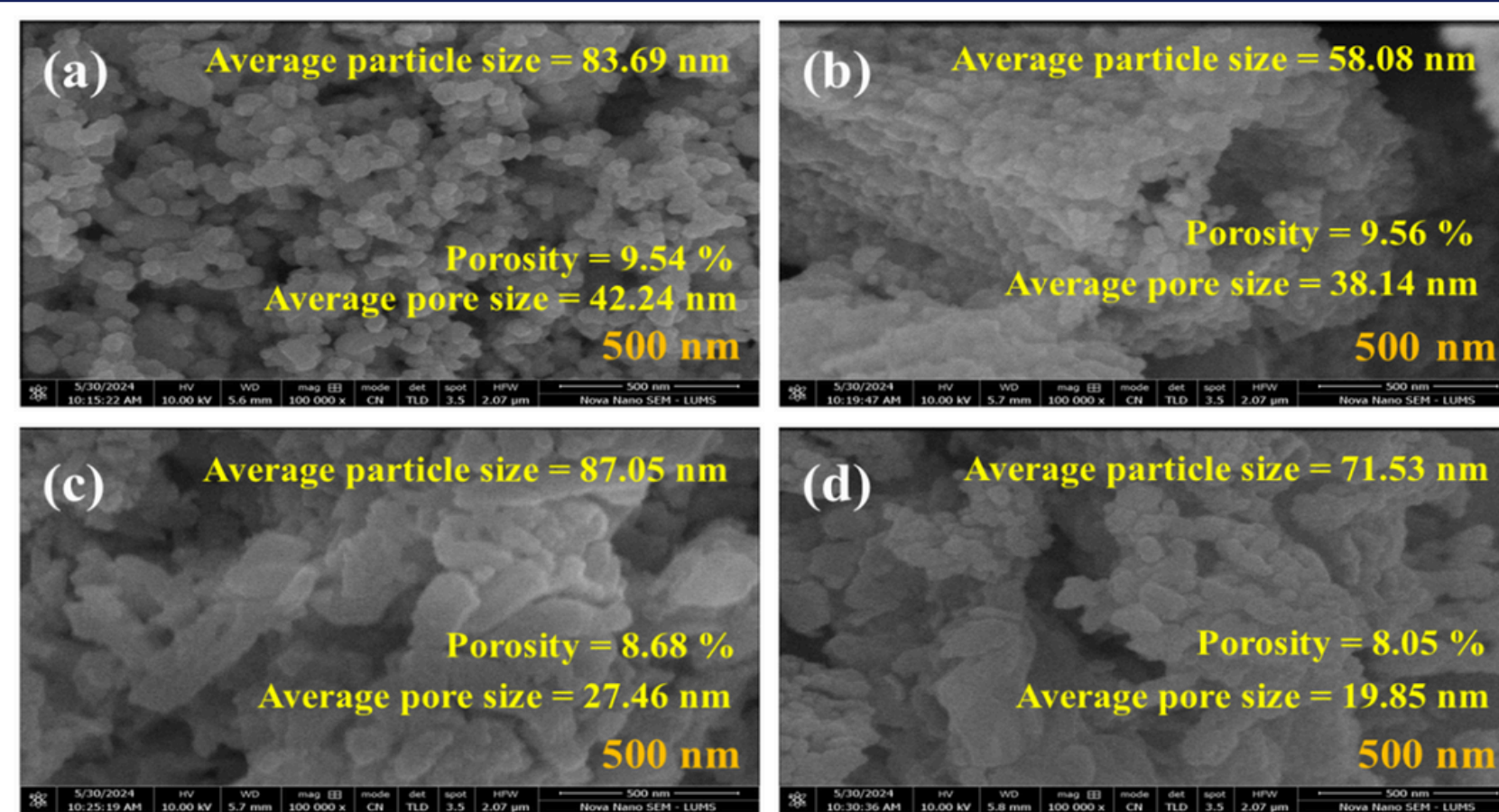
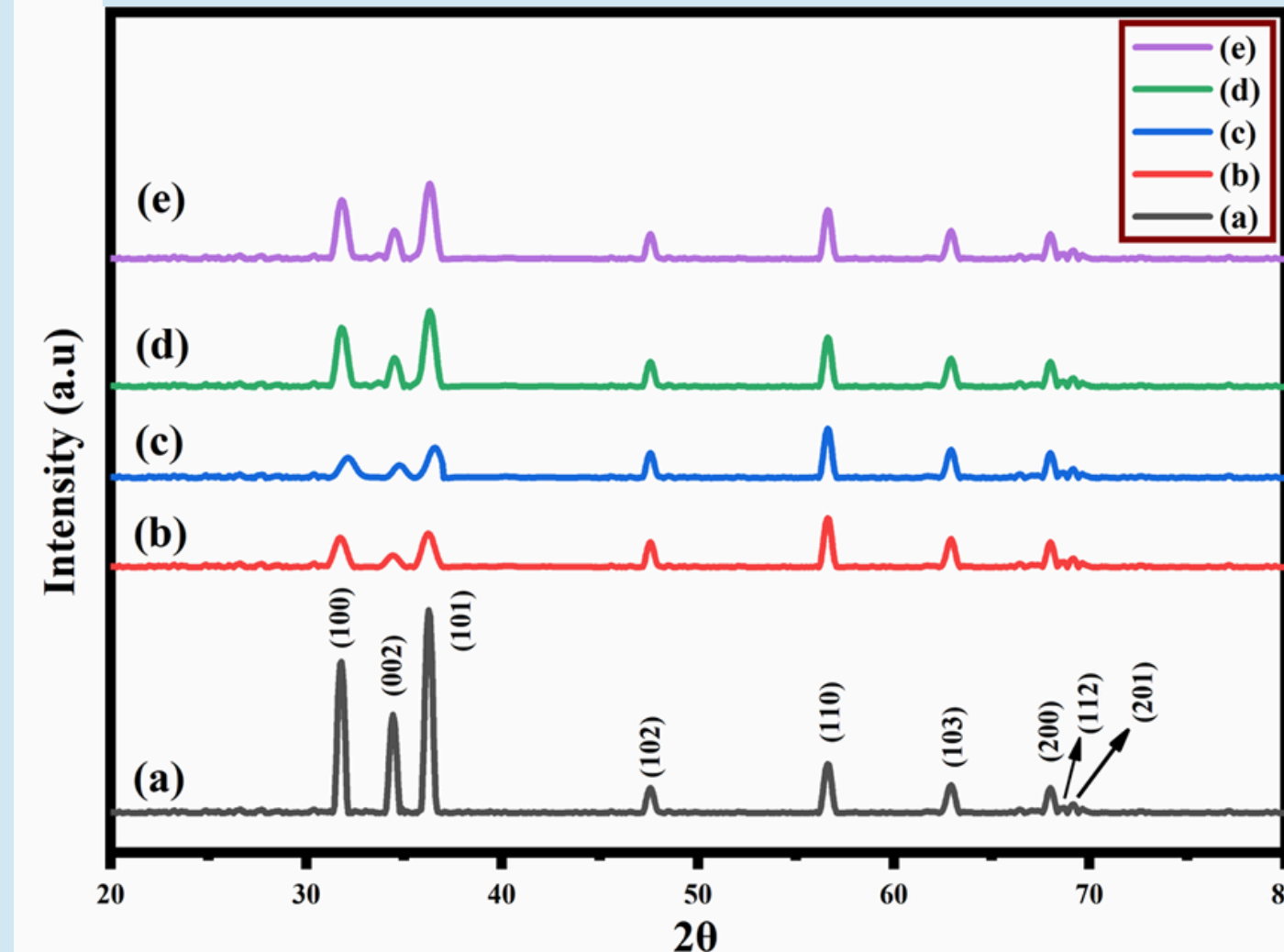
Resuability: 71.5% efficiency retained after five cycles.



03. Analysis

- XRD:** Crystal structure and crystallite size.
- SEM:** Surface morphology and particle size.
- EDX:** Elemental analysis.
- UV-Vis:** Optical properties and band gap.
- VSM:** Magnetic properties.

Zn_{0.95-x}Fe_{0.05}La_xO (a) x = 0 (b) x = 0.01 (c) x = 0.04 (d) x = 0.07 (e) x = 0.10



Significance

- Cost-effective, eco-friendly photocatalyst.
- Enhanced visible-light utilization.
- Potential for industrial wastewater treatment.

06. Conclusion

Fe–La co-doping significantly improved photocatalytic degradation, reduced band gap, and introduced room temperature ferromagnetism.

Future Work

- Real wastewater testing.
- Device integration (photocatalytic membranes, magnetic sensors).
- Scale-up for industrial use.

References

- Saeed, M., et al., "Recent advances, challenges, and future perspectives of ZnO nanostructure materials towards energy applications." 1(2024) 202300106.
- Ciciliati, M.A., et al., "Fe-doped ZnO nanoparticles: Synthesis by a modified sol–gel method and characterization." 159(2015) 84–86.

Acknowledgments

Supervisor, lab members, funding/support institutions.