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Biosynthesis of CuO and Ag-doped CuO nanoparticles using Flourensia cernua extract for photocatalytic dye degradation

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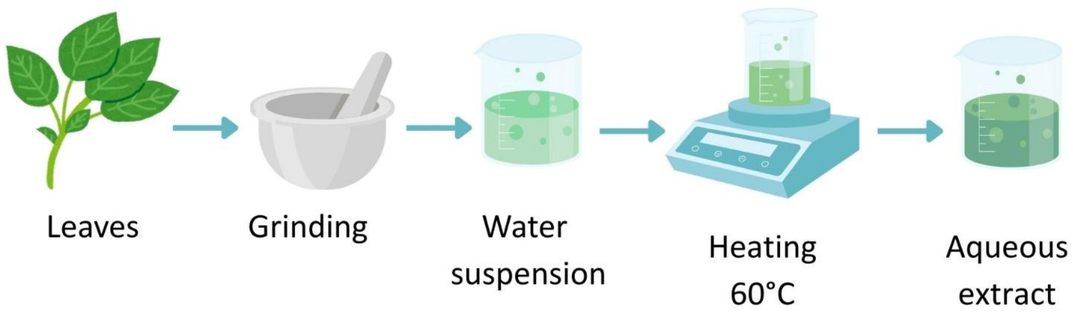
INTRODUCTION & AIM

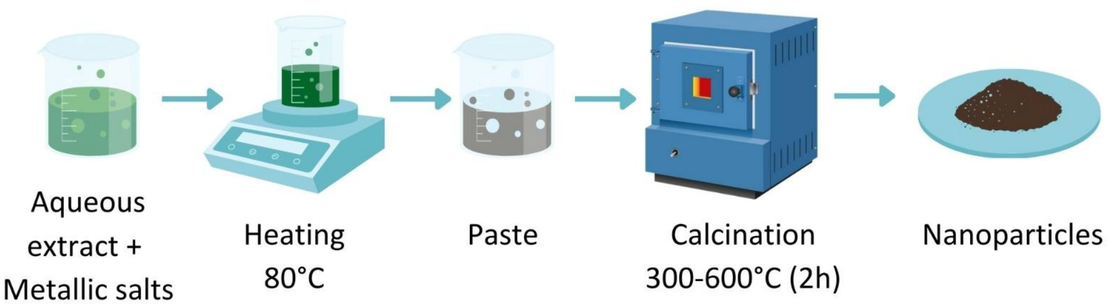
Water pollution is a global issue that affects many countries. In urban areas, water often becomes contaminated as a result of industrialization and may be saturated with organic pollutants, such as dyes like methylene blue. This contaminated water poses significant health risks to both humans and animals, contributing to environmental degradation. Thus, it is essential to properly treat water and remove these organic dyes before they are released into the ecosystem. Photodegradation is a chemical oxidation process that uses nanoparticles to effectively break down stable organic dyes, such as methylene blue. This study investigates CuO and Ag-doped CuO nanoparticles (NPs) synthesized using Flourensia cernua extract, focusing on their synthesis, physicochemical characteristics, and photocatalytic activity under sunlight. Green synthesis methods utilizing plant extracts offer environmentally benign routes for nanoparticle fabrication, attracting significant interest across multiple fields. The NPs were synthesized at varying temperatures, ranging from 300 to 600 °C, and characterized using X-ray diffraction (XRD), Fourier transform infrared spectrometry (FTIR), and transmission electron microscopy (TEM). The XRD patterns confirmed a monoclinic phase of CuO and the formation of Ag/CuO heterostructures in all de samples. TEM micrographs showed irregularly shaped nanoparticles with sizes below 30 nm. The results of the photocatalytic activity indicate that increasing Ag content accelerates the degradation of methylene blue.

METHOD

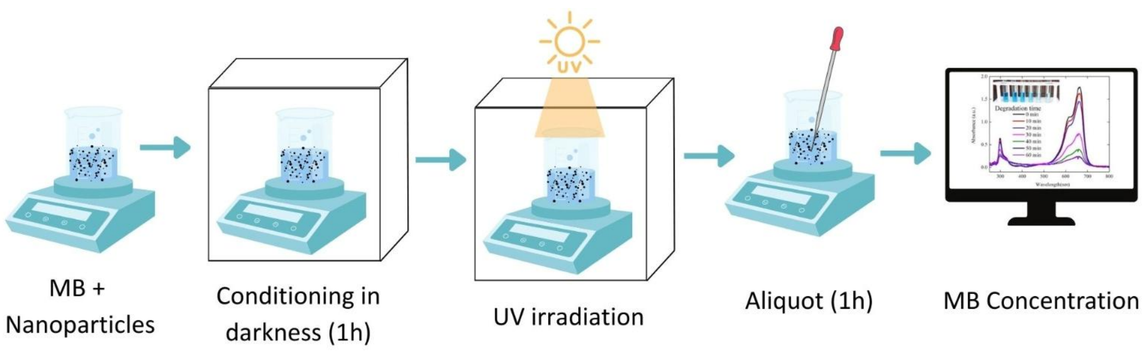
Preparation of extract



Preparation of nanoparticles

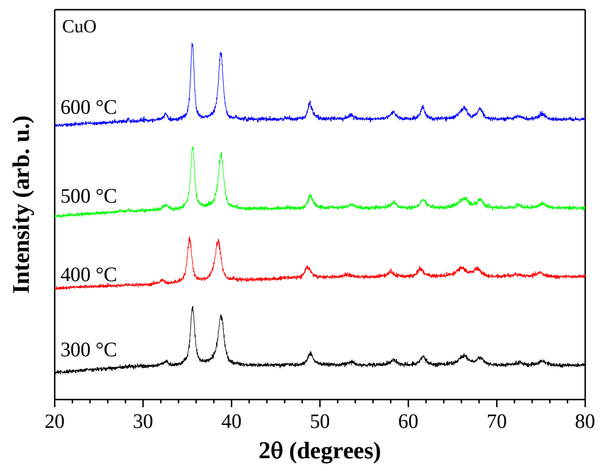


Photocatalysis test



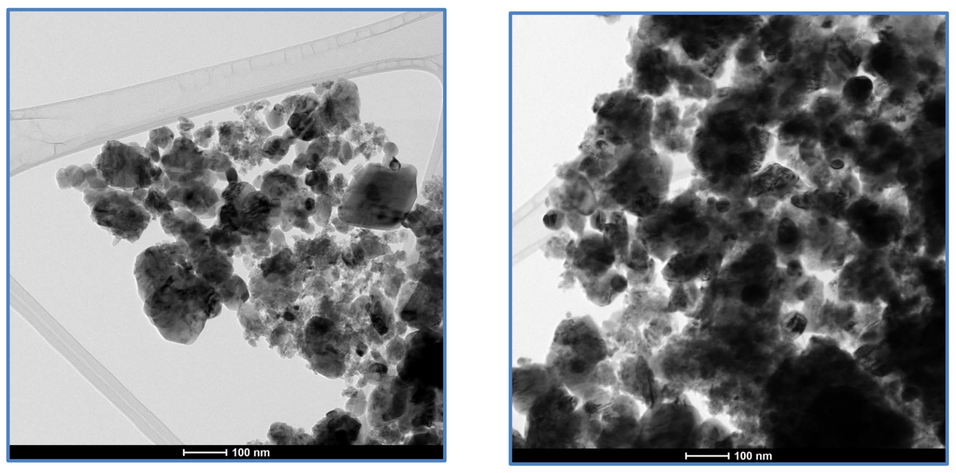
RESULTS & DISCUSSION

X-ray diffraction



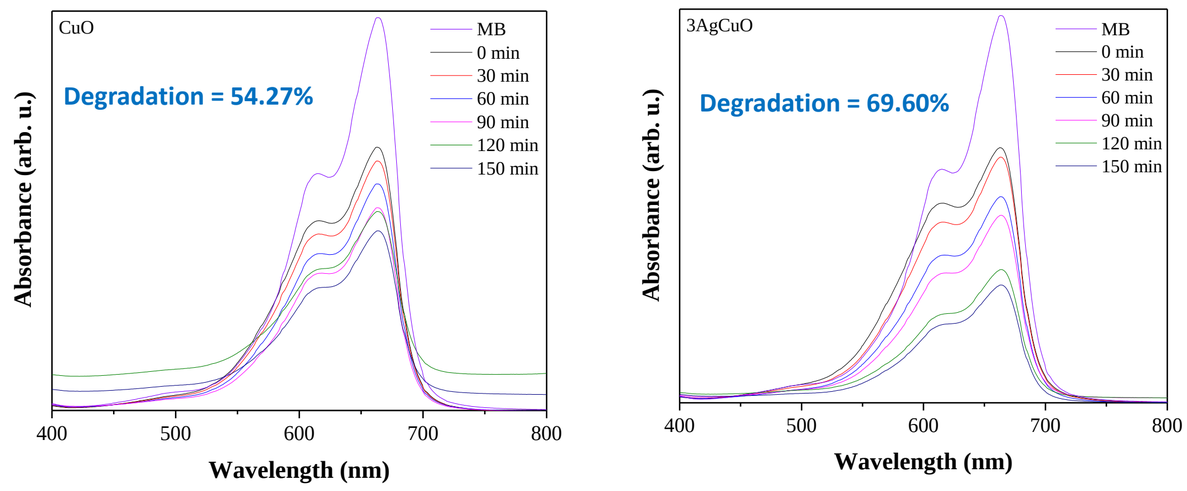
Sample	Crystallite size (D) (nm)	Sample	Crystallite size (D) (nm)	
	CuO		CuO	Ag
CuO - 300	13.73	3AgCuO - 300	10.68	12.02
CuO - 400	13.77	3AgCuO - 400	11.65	17.92
CuO - 500	15.04	3AgCuO - 500	12.81	32.17
CuO - 600	16.91	3AgCuO - 600	14.89	35.42

Transmission electron microscopy



Degradation studies

$$\% \, Degradation = \frac{(A_0 - A_t) \; / \; A_0}{100}$$



CONCLUSION

CuO and Ag-CuO nanoparticles were successfully synthesized using the extract of Flourensia cernua. The size of the crystallites in the nanoparticles is influenced by both the calcination temperature and the silver content. The sample with 3% Ag-CuO exhibited a higher efficiency for the degradation of methylene blue compared to CuO.

ACKNOWLEDGEMENTS

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