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Copper-based quantum dots for efficient photodegradation of methyl orange dye

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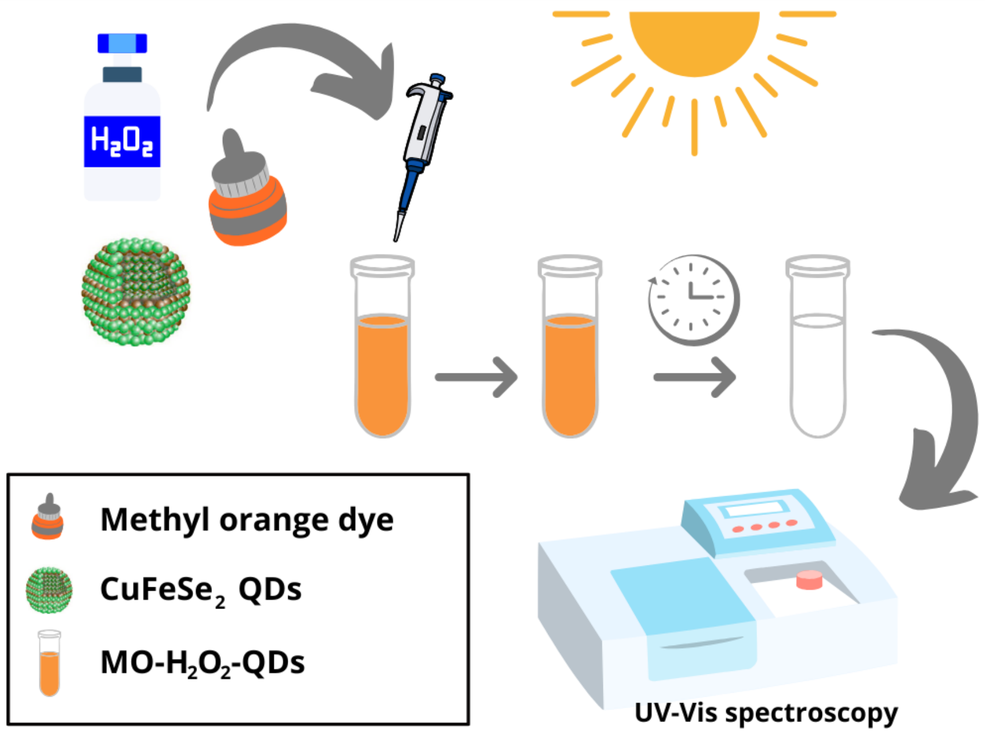
INTRODUCTION

In recent years, has increased the search for more sustainable technologies that minimize environmental impact while providing social benefits. Among the most common pollutants being addressed in natural and wastewater, dyes stand out as a significant concern. Advanced Oxidative Processes (APOs) stand out as one of the most widely used methodologies for environmental remediation [1]. Thus, photocatalysis has emerged as a more efficient strategy, as an alternative to commonly used AOPs. In this study, $CuFeSe_2$ quantum dots (QDs) were used as the semiconductor material and sunlight as the energy source to drive the reduction reactions. QDs are particularly notable due their unique optical properties, as well as their low production costs. Additionally, these nanocrystals can catalyze the decomposition of H_2O_2, leading to the generation of anionic radicals [2]. Herein, a 10 ppm solution of methyl orange (MO) dye was brought into contact with the QD suspension, both in the presence and absence of H_2O_2, and exposed to a full-spectrum solar lamp, simulating sunlight.

METHOD

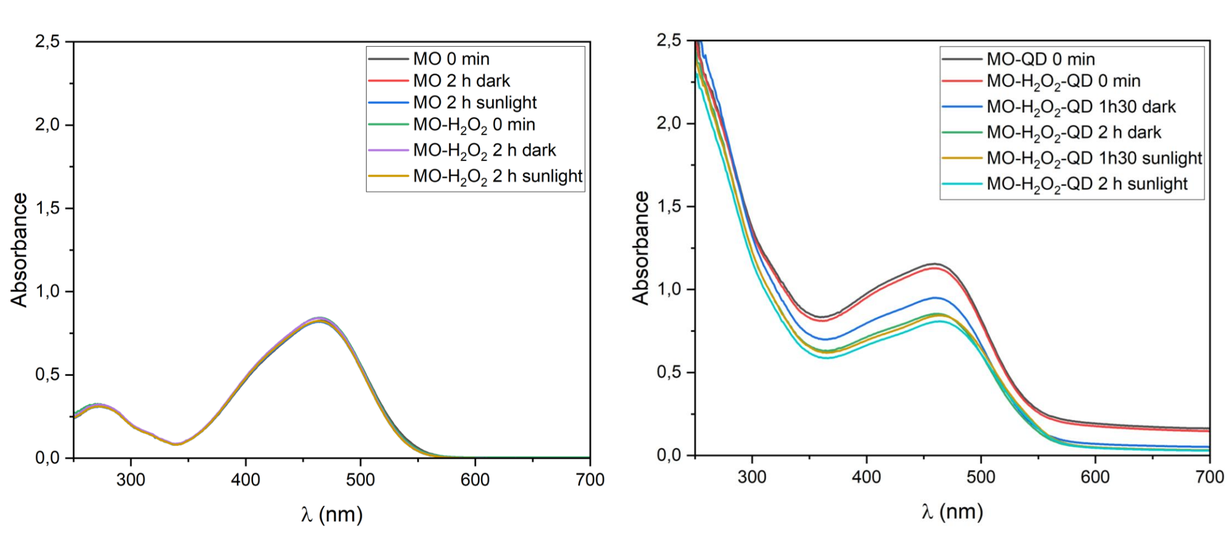


Sample composition for a final volume of 3 mL.

Component	Concentration	V (mL)
MO	10 ppm	1.57
H_2O_2	0.1 M	0.10
$CuFeSe_2$ QD	-	1.00

RESULTS & DISCUSSION

Absorption spectra of the assays in dark and sunlight.



Dye removal percentage in the samples at different times in the absence and under sunlight.

Sample	C/C₀ (%) Dark	Sun
MO-H_2O_2 0 min	100	100
MO-H_2O_2 2 h	99.7	97.4
MO-QD 0 min	100	100
MO-QD 2 h	90.2	90.3
MO-H_2O_2-QD 0 min	96.6	96.6
MO-H_2O_2-QD 1h30	73.6	60.2
MO-H_2O_2-QD 2h	61.4	55.8

CONCLUSION

The preliminary results showed a decrease of MO concentration in the presence of QDs, H_2O_2, and light irradiation. These results represent a promising advancement in photodegradation technology while reinforcing a commitment to environmental sustainability.

ACKNOWLEDGEMENTS

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CNPq Conselho Nacional de Desenvolvimento Científico e Tecnológico

FCT Fundação para a Ciência e a Tecnologia — Governo de Portugal — Ministério da Educação e Ciência

dQF Departamento de Química Fundamental

FACEPE Fundação de Amparo à Ciência e Tecnologia do Estado de Pernambuco

CESAM Centre for Environmental and Marine Studies

REFERENCES

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[2] Shen, H. *et al*. **2022**. 10.3390/nano12183130.