



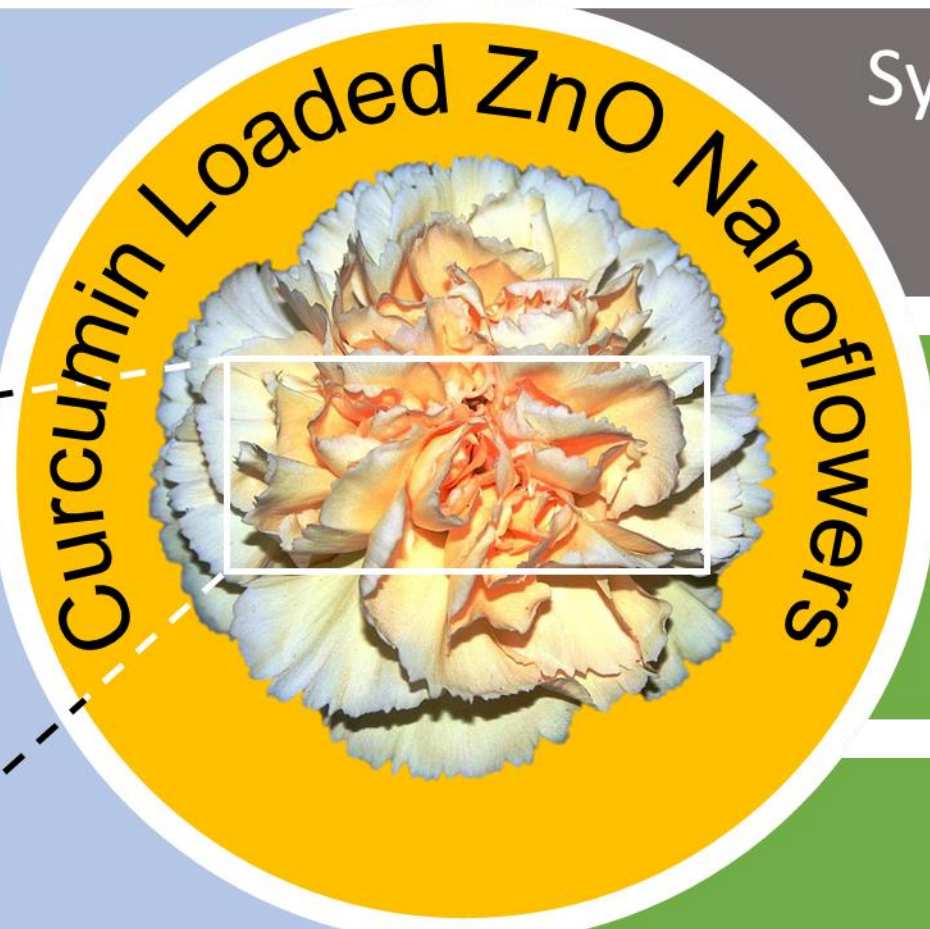
Curcumin Loaded ZnO Nanoflowers: A Novel Paradigm of Harnessing the Beauty of Nanoscale Morphologies for Synergistic Enhancements in Nanocomposite Properties

W. A. Nilushi Pramodi¹, Lahiru Wijenayaka¹, Ranga Dissanayake², and Asha Wickramapala¹

(1) Department of Chemistry, The Open University of Sri Lanka, (2) Department of Pharmacy, University of Sri Jayewardenepura, Sri Lanka



ZnO nanoflowers with enhanced functionalization with curcumin due to increased surface area



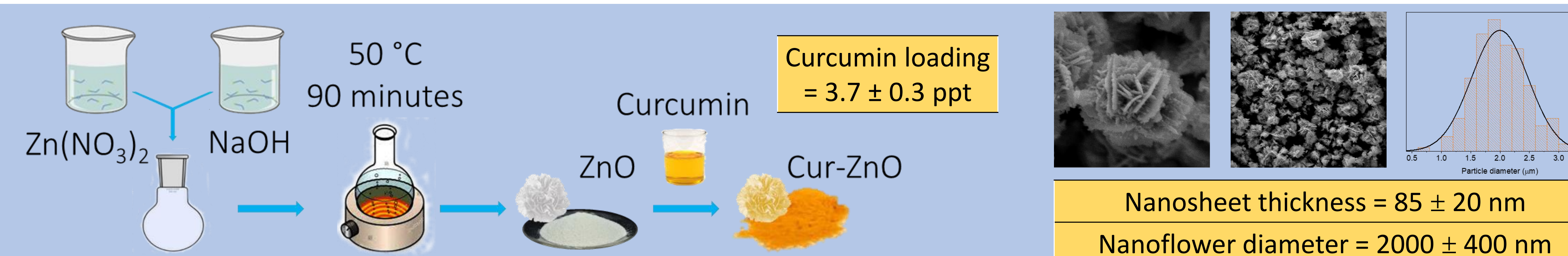
Synergistically Enhanced Photocatalysis for Water Purification

Enhanced Antimicrobial Activity

Enhanced Antioxidant Activity

Enhanced Anticancer Activity

Synthesis and Characterization



Overview

A paramount challenge in material science is engineering novel, composite, and environmentally and biologically compatible materials with improved properties. Ironically, the most compatible nanoscale morphology, the well-studied spheres, poses restrictions in applicability, specifically due to limited surface area it allows for functionalization in engineering advanced materials.

Hypothesis

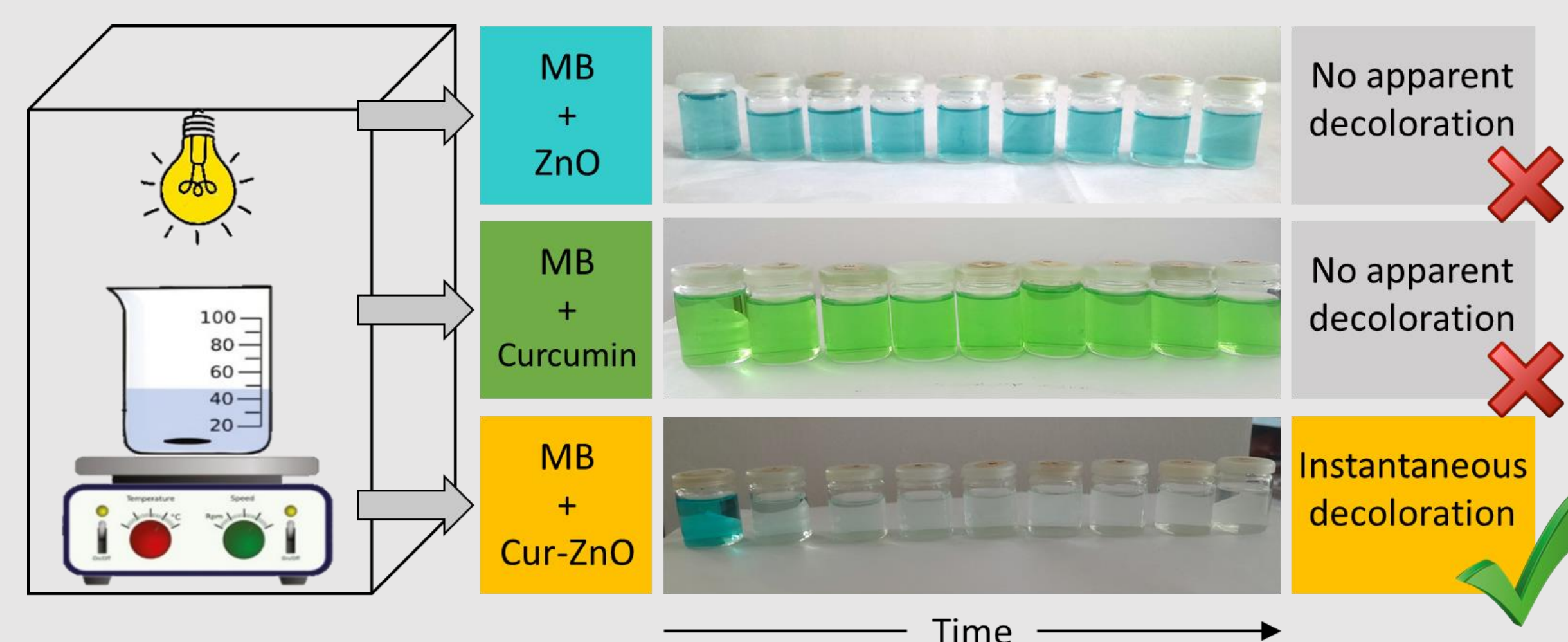
The superficially spherical nature of ZnO nanoflowers allow compatibility, while the presence of surface and internal crevices allow increased area for functionalization leading to synergistic enhancements in properties.

Research Objectives

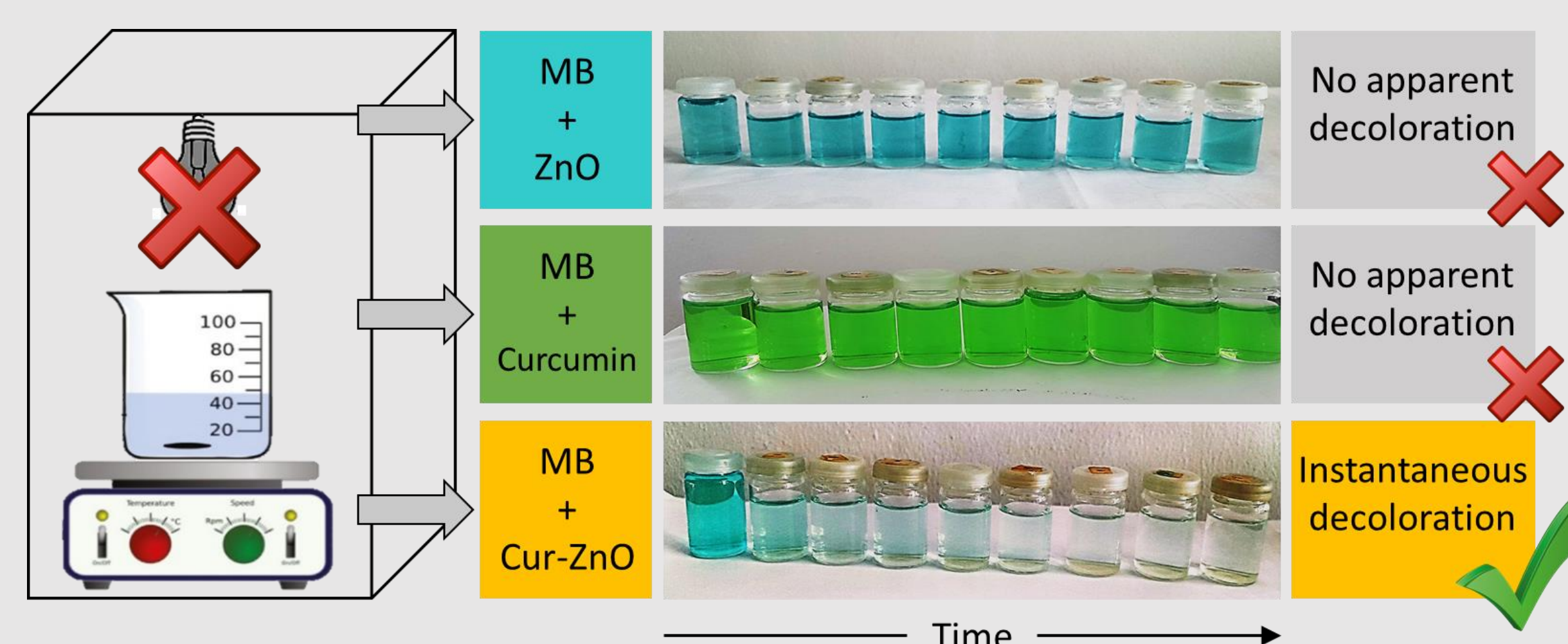


Water Purification via Synergistic Photocatalysis

Methylene blue (MB) degradation under simulated sunlight



Methylene blue (MB) degradation in absence of light

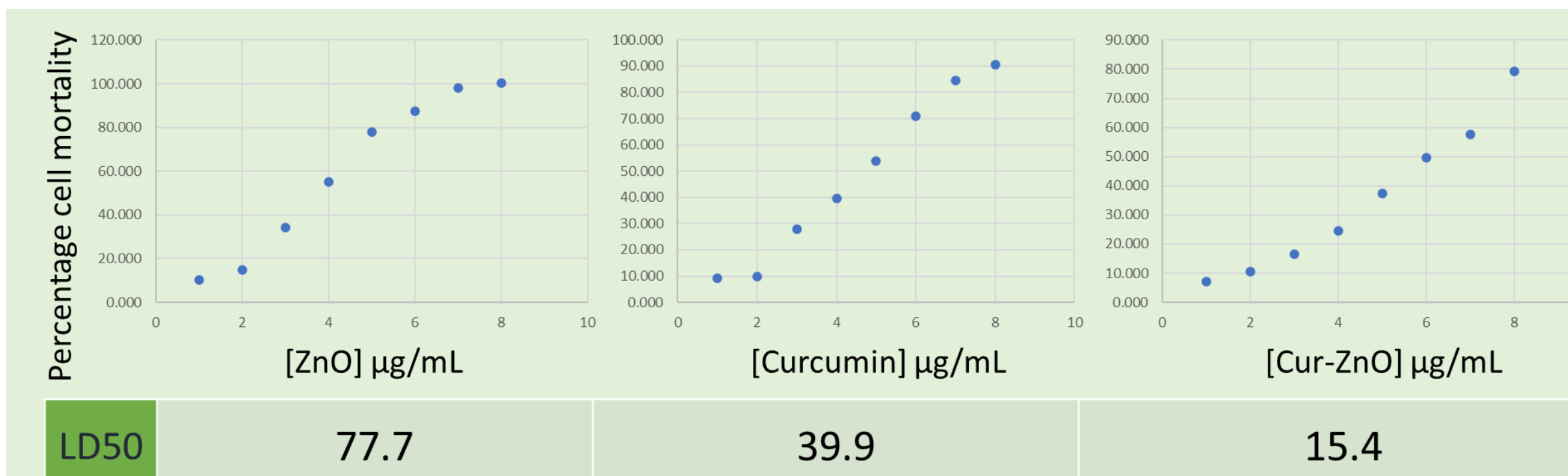


Cur-ZnO produced extremely efficient and strongly synergistic photocatalysis, even in the absence of light. Hence, it would be a promising platform for efficient water purification.

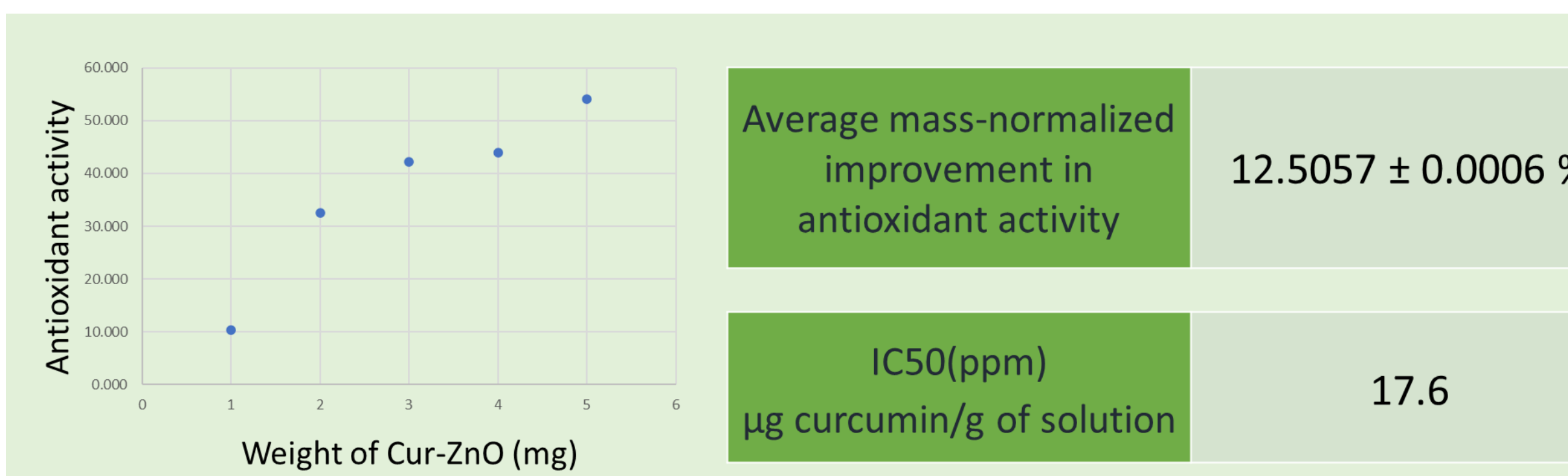
Antimicrobial Activity

	Bacillus subtilis	P. aeruginosa	E. coli	Candida tropicalis	Candida albicans
ZnO	9.78 ± 0.06	10.67 ± 0.06	15 ± 1	9.67 ± 0.06	13.33 ± 0.06
Curcumin	10.7 ± 1.5	6.33 ± 0.06	12 ± 1	9 ± 1	7.67 ± 0.06
Cur-ZnO	11 ± 1	11 ± 0	16.33 ± 0.06	9.33 ± 0.06	10 ± 0
Control	18.67 ± 0.06	19.33 ± 0.06	25.33 ± 0.06	8.67 ± 0.06	8.33 ± 0.06

Anticancer Activity for Breast Cancer Cell Line BT-474



Antioxidant Activity



Summary of Key Findings

Superficially spherical ZnO nanoflowers synthesized via a facile low-temp synthesis

Surface loading of curcumin quantified to be profoundly high (3.7 ± 0.3 ppt)

Extremely efficient synergistic photocatalysis, even in absence of light

Enhancements in antimicrobial, anticancer, and antioxidant activity

Conclusions and Potential Future Direction

The novel, superficially spherical nanoarchitecture with enhanced surface area for functionalization was proven to be a promising platform for synergistically improving the activity of nanocomposites. The concept can be utilized further in designing a wide array of novel nano-architectures with enhancements in ensuing applicability.

References

- Okpala, C.C., 2013. Nanocomposites—an overview. International Journal of Engineering Research and Development, 8(11), pp.17-23.
- Pramanik, P.K.D., Solanki, A., Debnath, A., Nayyar, A., El-Sappagh, S. and Kwak, K.S., 2020. Advancing modern healthcare with nanotechnology, nanobiosensors, and internet of nano things: Taxonomies, applications, architecture, and challenges. IEEE Access, 8, pp.65230-65266.
- Wang, X., Zhao, Y., Mølhave, K. and Sun, H., 2017. Engineering the surface/interface structures of titanium dioxide micro and nano architectures towards environmental and electrochemical applications. Nanomaterials, 7(11), p.382.
- Scarisoreanu, M., Ilie, A.G., Goncearenco, E., Banici, A.M., Morjan, I.P., Dutu, E., Tanasa, E., Fort, I., Stan, M., Mihailescu, C.N. and Fleaca, C., 2020. Ag, Au and Pt decorated TiO₂ biocompatible nanospheres for UV & vis photocatalytic water treatment. Applied Surface Science, 509, p.145217.
- Xu, F., Tang, Z., Huang, S., Chen, L., Liang, Y., Mai, W., Zhong, H., Fu, R. and Wu, D., 2015. Facile synthesis of ultrahigh-surface-area hollow carbon nanospheres for enhanced adsorption and energy storage. Nature communications, 6(1), p.7221.

Acknowledgement

We acknowledge the Department of Chemistry, The Open University of Sri Lanka for providing the facilities for conducting this research.