

Harnessing the Power of Visible Light with GO-Ni-ZnO Nanohybrid Electrospun Polymeric Membranes for Improved Photocatalysis: A Focused Approach to Fabrication, Characterization, and Applications

Viraj Pasindu¹, Piumika Yapa¹, Sanduni Dabare¹, Imalka Munaweera^{1*}, Thusitha Etampawala², Manjula M. Weerasekera³, Dinesh Attygalle⁴, Shantha Amarasinghe⁴

¹ Department of Chemistry, Faculty of Applied Sciences, University of Sri Jayewardenepura, Nugegoda (10250), Sri Lanka.

² Center for Nanocomposite Research, Faculty of Applied Sciences, University of Sri Jayewardenepura, Nugegoda (10250), Sri Lanka.

³ Department of Microbiology, Faculty of Medical Sciences, University of Sri Jayewardenepura, Nugegoda (10250), Sri Lanka.

⁴ Department of Material Science and Engineering, Faculty of Engineering, University of Moratuwa, Sri Lanka.

* imalka@sjp.ac.lk

Photocatalysis exhibits considerable potential for a range of environmental, energy, and biomedical applications, especially when employing metal-doped nanoparticle systems like Ni-doped ZnO. By giving nanohybrid stability and structural support, graphene oxide (GO) enhances photocatalytic activities and increases its durability and resistance to photo-corrosion. Electrospinning is used to create GO-Ni-ZnO nanohybrid membranes, which are then characterized by FTIR, Raman spectroscopy, SEM, XRD, and UV diffuse reflectance spectroscopy. The outcomes show a notable improvement in the organic dye methylene blue's photocatalytic breakdown when exposed to visible light, underscoring the membranes' potential for environmental remediation and wastewater treatment. After 15 minutes, a nanohybrid consisting of 4% graphene oxide (GO) and 5% nickel-doped zinc oxide (Ni-doped ZnO) incorporated into a cellulose acetate electrospun mat produced the greatest photocatalytic activity of 93.41%. This outcome validates the nanohybrid system's synergistic benefits. The DPPH assay was used to measure radical scavenging activity (RSA), which is thought to be the main mechanism underlying this occurrence. With a rate constant of 0.3208 mM/min for the nanoparticles, the nanohybrid mat showed the highest RSA, achieving 80.44% of radical scavenging activity after 60 minutes. This electrospun mat's gap energy, which

was measured at 3.1346 eV, provides more evidence of the nanohybrid system's efficacy in visible light. Furthermore, an antimicrobial test demonstrated the mat's potent antibacterial qualities, showing the biggest zones of inhibition (between 25.5 and 33.0 mm) against pathogens like *Salmonella typhi*, *Shigella sonnei*, *Candida albicans*, *Escherichia coli*, and *Staphylococcus aureus*. All things considered, GO-Ni-ZnO nanohybrid electrospun membranes offer a viable strategy for raising photocatalytic efficiency, providing affordable and environmentally friendly answers for a range of uses.

Keywords:

Photocatalysis; Dye degradation; Semiconductor; Electrospinning; Antimicrobial.

Acknowledgment:

Financial support for this study is acknowledged by the University of Sri Jayewardenepura, Sri Lanka under the research grant number ASP/ 01/ RE/ SCI/ 2022/15 and The World Academy of Science (20/102/ RG/ CHE/ AS_1 - FR3240314134) for providing grants for the electrospinning setup. Authors acknowledge the Instrument Centre, Faculty of Applied Sciences, University of Sri Jayewardenepura for the facility provided in analysis and characterization.