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Facile green synthesis of Ag capped ZnO nanoparticles using catharanthus roseus extract and their evaluation of antimicrobial activities.

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Nanotechnology involving green synthesis of nanoparticles has become an eye-catching idea and has gained much importance due to its great facility, non-toxic chemicals used, cost-effective and being ecofriendly. Recently, it focuses on developing innovative methods of preventing, diagnosing and treating different kind of diseases. In the present study, we have compared the physical and antimicrobial activity of leaf and flower extract from catharanthus roseus plant by employing facile and inexpensive green synthesized Ag doped ZnO NPs. The resultant products were thoroughly analyzed using different analytical techniques such as UV-Vis NIR spectrophotometer, Scanning electron microscope, Fourier Transform Infrared spectrophotometer and X-ray diffraction technique. The XRD patterns reveal that the synthesized NPs exhibit clear crystallization with (101) as a growth direction. The optical absorption studies indicate that the C. roseus leaf loaded Ag: ZnO NPs show higher absorption when compared to the flower mediated NPs. It can be concluded that the leaves and flowers of C.roseus can be the good source for the synthesis of silver doped ZnO nanoparticles. The antibacterial and antifungal activities of leaf and flower mediated Ag:ZnO nanoparticles were evaluated by agar well diffusion method against three microbial gram positive and gram negative strains. It was observed that a high significant antioxidant activity against DPPH free radicals. A maximum radical scavenging activity of 76% and 72% was observed for the Leaf and Flower mediated Ag:ZnO nanoparticles.

Keywords: Catharanthus roseus, Silver, Nanoparticles, Green synthesis, Antibacterial, Antifungal, Antioxidant.

Biocatalyst coupling with Mo-doped SnO₂ nanoparticles for efficient photocatalytic dye degradation: An eco-friendly approach for environmental remediation

R. Shalini, K. Ravichandran, P. Kavitha, P. K. Praseetha, R. Mohan & P. Ravikumar

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RESEARCH ARTICLE



Biocatalyst coupling with Mo-doped SnO₂ nanoparticles for efficient photocatalytic dye degradation: An eco-friendly approach for environmental remediation

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ABSTRACT

Specifically, biocatalyst coupled semiconductor photocatalysts have great potential towards the eco-friendly decomposition of toxic organic dyes that contaminate water bodies. This study reports the synthesis of vermiwash activated molybdenum doped tin oxide (Mo:SnO₂) nanomaterial, for the photocatalytic degradation of a representative cationic dye - methylene blue (MB). The photocatalytic performance of the synthesized nanoparticles was evaluated using UV-visible (UV-vis) spectroscopy and the degrading efficiency of MB dye was quantified. The addition of vermiwash resulted in a marked improvement in the photocatalytic activity of Mo:SnO₂ nanoparticles, with a degradation efficiency of 96% achieved after 75 min of irradiation. The nanoparticles were characterized using XRD, SEM-EDX, TEM, FTIR, XPS and UV-vis to confirm the crystal structure, morphology, functional groups, elemental analysis and bandgap energy by using Tauc's plot. The study demonstrates the potential of vermiwash as a green and efficient bio-catalyst for improving the photocatalytic activity of Mo:SnO₂ nanoparticles regarding the degradation of textile effluents. Thus, this study paves a way for new eco-friendly approach for the synthesis of cost-effective, biocatalyst coupled semiconductor photocatalyst.

ARTICLE HISTORY

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KEYWORDS

Mo-doped SnO₂ nanoparticles; bandgap engineering; bio-catalyst; photodegradation efficiency; environmental remediation; wastewater treatment

1. Introduction

Discharge of untreated waste water from the textile industry has been a significant environmental problem, affecting both human health and eco-systems (Nethravathi et al. 2022). Textile waste water contains a variety of harmful chemicals such as dyes, bleaches and detergents, which can pollute the water bodies such as rivers and lakes. These pollutants can cause oxygen depletion in the water, leading to the death of aquatic organisms. When the waste water is disposed on land, it can contaminate the soil, which can impact the agriculture and plant growth (Khalid et al. 2018; Kishor et al. 2021; Al-Tohamy et al. 2022; Azanaw et al. 2022; Castillo-Suárez et al. 2023). It can accumulate in the food chain and cause health problems such as cancer, neurological damage and birth defects.

Development of efficient and sustainable strategies for degrading the organic pollutants in water is a major challenge in environmental science. Photocatalytic

degradation using nanoparticles has emerged as a promising approach due to its ability to effectively remove a wide range of pollutants under mild reaction conditions (Nethravathi et al. 2022). In recent years, the development of efficient and eco-friendly photocatalysts has been the focus of intense research (Deletic and Wang 2019; Batra et al. 2022; Hazaraimi et al. 2022; Subhiksha et al. 2022). Photocatalysis is a promising technology for treating textile dyes in wastewater because it can breakdown the dye molecules into harmless by-products using light energy (Kumari et al. 2023). The efficiency of photocatalysis can be improved by optimizing the parameters, like pH (Ravichandran et al. 2023), process temperature (Buzuayehu Abebe et al. 2020) and catalyst loading (Das et al. 2018). The main advantages of photocatalytic water treatment are: low-cost, low-power consumption and involving less complex process. In addition, it can be easily scale up for industrial applications; it does not produce any harmful



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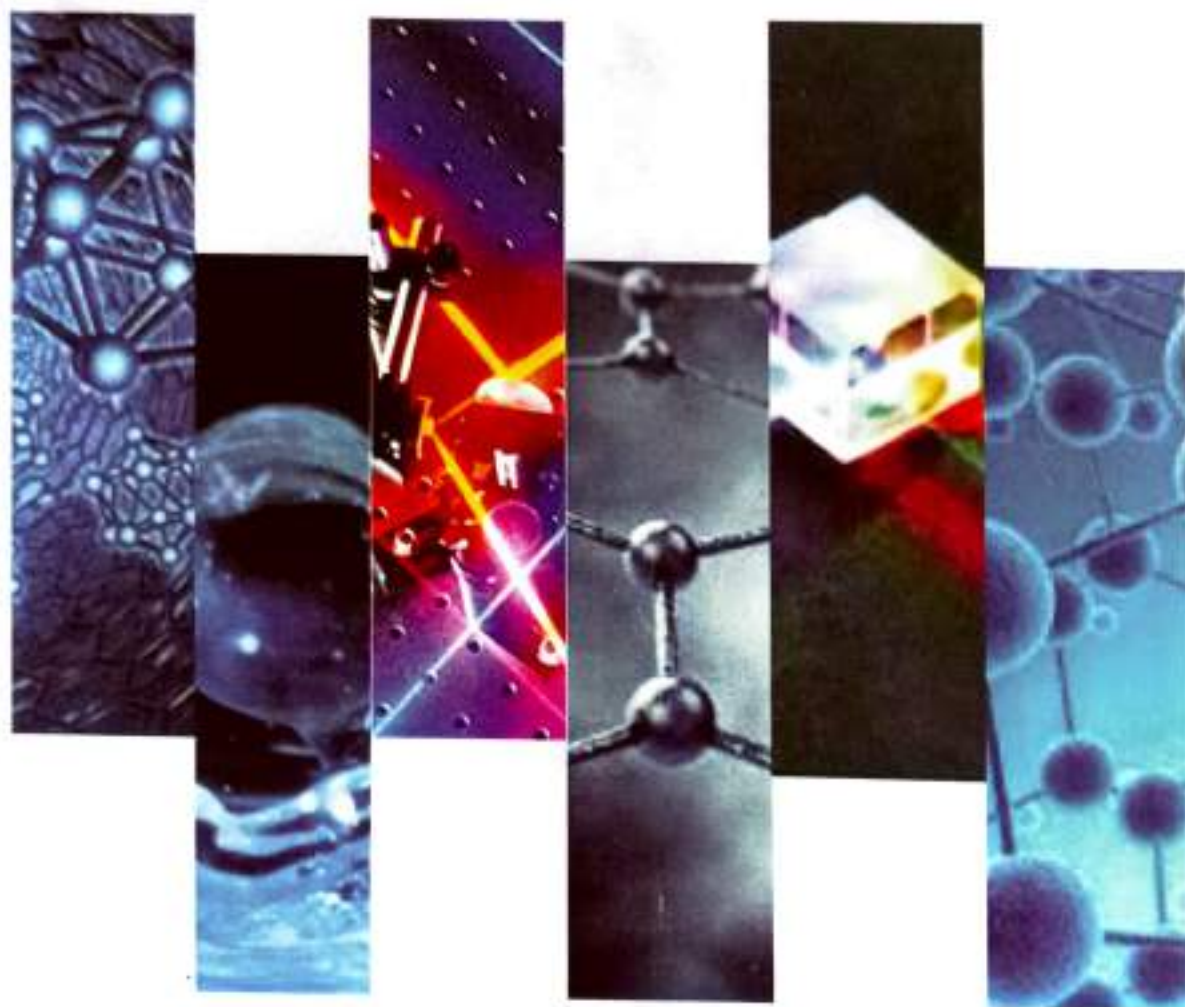


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(As per the syllabus of Bharathidhasan University, Tiruchirappalli)



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About the Book

Materials science is a relatively new and very broad field. It involves applications from a number of scientific disciplines that contribute to the creation of new materials. The central theory behind materials science involves relating the microstructure of a material to its macromolecular physical and chemical properties. Recently, researchers are urged to contact associations for ceramic manufacturers, synthetic rubber makers, paints and coatings manufacturers, and plastics makers to find out more about each of these areas and the opportunities that exist for materials scientist in each of them.

As materials science field is made up of people with various educational backgrounds, most projects in materials science are team efforts, including technicians, engineers, physicists, chemists and materials scientists. This book gives the knowledge of characteristics and role of various classes of materials which are playing a unique role in the society. This book is designed on the syllabus of Major based Elective paper, Bharathidhasan University, Tiruchirappalli and hence it can be useful for the young researchers for the preparation of their career tracks.



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