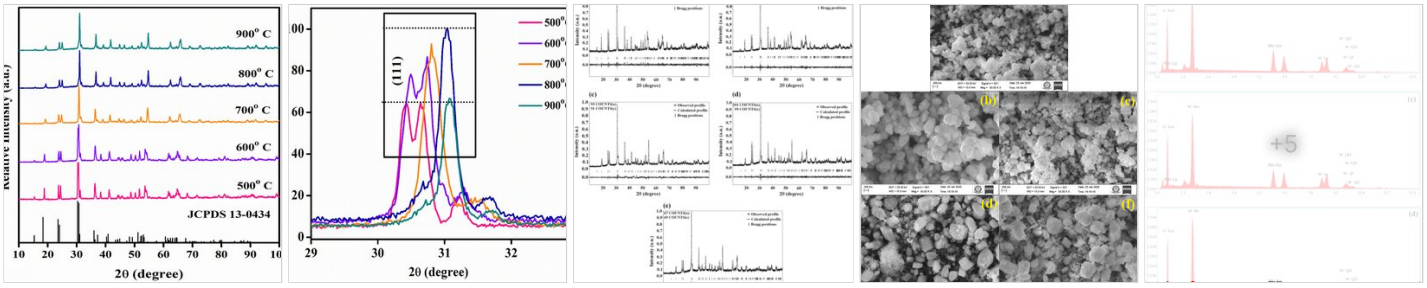
DOI: 10.1007/s10832-023-00325-x

Lalitha Kamarasu · Satya Sree Nannapaneni · Saravanavadivu Arunachalam · Show all 6 authors · Sivaganesh Dhanushkodi

Abstract and figures

The growing concern of drug pollution in water bodies, particularly the presence of pharmaceutical drugs like Diclofenac (DF), has prompted the emergence of photocatalytic degradation as a promising solution, driving the need for efficient photocatalysts to mitigate potential risks to aquatic ecosystems and human health. In this study, the influence of temperature on the degradation of DF (name of the drug) using MnWO4 (manganese tungstate) as a photocatalyst is investigated. The precise co-precipitation method was used to synthesize MnWO4, which was subsequently calcined at different temperatures ranging from 500 °C to 900 °C. The physicochemical properties of synthesized materials were investigated by various analytical and spectrocopical techniques. Significantly, MnWO4 calcinated at 800 °C demonstrated exceptional photocatalytic performance, achieving a degradation rate exceeding 98% for DF under visible-light illumination. This superior activity can be attributed to factors such as excellent crystallinity, a well-defined morphology, a superior optical band gap for effective utilization of visible light, and reduced particle size compared to other MnWO4 materials. This work paves valuable insights into the temperature-dependent synthesis and properties of MnWO4 as a photocatalyst for DF degradation. The exceptional photocatalytic performance observed at 800 °C highlights the potential of MnWO4 as an efficient and environmentally friendly material for drug decomposition under visible-light conditions.



Page 1

for drug degradation

Lalitha Kamarasu[1,2] · Satya Sree Nannapaneni[2] · Saravanavadivu Arunachalam[3] · Padmapriya Arumugam[4] · Naresh Kumar Katari[5] · D. Sivaganesh[6]

Received: 15 January 2023 / Accepted: 23 July 2023 / Published online: 25 August 2023

Abstract

The growing concern of drug pollution in water bodies, particularly the presence of pharmaceutical drugs like Diclofenac (DF), has prompted the emergence of photocatalytic degradation as a promising solution, driving the need for efficient photocatalysts to mitigate potential risks to aquatic ecosystems and human health. In this study, the influence of temperature on the degradation of DF (name of the drug) using $MnWO_4$ (manganese tungstate) as a photocatalyst is investigated. The precise co-precipitation method was used to synthesize $MnWO_4$, which was subsequently calcined at different temperatures ranging from 500 °C to 900 °C. The physicochemical properties of synthesized materials were investigated by various analytical and spectrocopical techniques. Significantly, $MnWO_4$ calcinated at 800 °C demonstrated exceptional photocatalytic performance, achieving a degradation rate exceeding 98% for DF under visible-light illumination. This superior activity can be attributed to factors such as excellent crystallinity, a well-defined morphology, a superior optical band gap for effective utilization of visible light, and reduced particle size compared to other $MnWO_4$ materials. This work paves valuable insights into the temperature-dependent synthesis and properties of $MnWO_4$ as a photocatalyst for DF degradation. The exceptional photocatalytic performance observed at 800 °C highlights the potential of $MnWO_4$ as an efficient and environmentally friendly material for drug decomposition under visible-light conditions.

Keywords $MnWO_4$ · PXRD · Rietveld method · Diclofenac · Degradation

1 Introduction

Energy shortages and environmental pollution have been widespread concerns over the past few decades [1, 2]. Nonetheless, the quick blossoming of the pharmaceutical industry creates hazardous effluent during development and production and contaminates soil and water systems when discharged [3–5]. Among the pharmaceutical drugs, DF is a widely used medicine that reduces swelling (inflammation) and pain. It's used to treat aches and pains, as well as problems with joints, muscles, and bones such as rheumatoid arthritis, sprains, back pain, toothache, migraine, gout, and ankylosing spondylitis [6, 7]. DF drugs, known for their incomplete metabolism in the environment and adverse effects on humans and animals such as chronic and pulmonary toxicity, present a significant concern for researchers. Therefore, the search for unique and efficient materials with high photodegradation efficacy is a key focus. Photocatalytic materials capable of degrading persistent aromatic compounds, which do not degrade naturally in the environment, have gained considerable interest. Photocatalytic strategies offer an environmentally friendly solution by utilizing sunlight to convert organic materials into green compounds [8, 9]. This approach addresses the challenge of persistent pollutants and their potential hazards. By harnessing the power of photocatalysis, researchers aim to provide a sustainable approach for remediation and purification of contaminated

✉ Satya Sree Nannapaneni
satyasreenannapaneni@gmail.com

1 Department of Chemistry, Vasireddy Venkatadri Institute of Technology, AndhraPradesh 522508 Nambur, India

2 Department of Chemistry, VFSTR (Deemed to be University), Vadlamudi, 522213 Guntur, Andhra Pradesh, India

3 Department of Electrochemistry, Saveetha School of Engineering, Saveetha Institute of Medical and Technical Sciences, Thandalam, Chennai 602105, Tamil Nadu, India

4 Technology and Advanced Studies (VISTAS), Vels Institute of Science, Tamil Nadu, India

5 Department of Chemistry, Gandhi Institute of Technology and Management (Deemed to be University), Hyderabad 502329, Telangana, India

6 Ural Federal University, Mira str, Yekaterinburg, Russia

Export citation

Inorganic Chemistry Communications

Lalitha Kamarasu · Satya Sree Nannapaneni · Saravanavadivu Arunachalam · [...] · Naresh Kumar Katari

We have synthesized different concentrations of graphitic carbon nitride (GCN) (20 %, 40 %, 60 %, and 80 %) decorated manganese oxide (Mn2O3) for photocatalytic degradation of the organic contaminant methylene blue (MB) in the current study. Powder X-ray diffraction (PXRD) research was used to investigate the crystalline nature of synthesized GCN-coated Mn2O3. Scanning electron microscopy (SEM) analysis was...

Read more

View

Three dimensional atomistic-scale electron density distribution analysis of ZnWO4: Sm phosphors

Article

October 2021 · 32 Reads · 9 Citations

Optik

Saravanakumar Subramanian · Sivaganesh Dhanushkodi · Sivakumar . V · [...] · Israel Samuel

In this work, we demonstrate a study of three-dimensional atomic-scale electron density distribution analysis for Sm^{3+}-doped ZnWO4 phosphors. The rare-earth element Sm^{3+} doped in ZnWO4 host with various concentrations via chemical precipitation technique for understanding their photoluminescence properties and bonding characteristics. The density of the electrons along the bond path was carrie...

Read more

View

ZnWO 4 : Eu 3+ Phosphor with Intense Blue LED Excitation: Photoluminescence and Electron density distribution Analysis

Article

July 2020 · 44 Reads · 16 Citations

Luminescence

Sivaganesh Dhanushkodi · Saravanakumar Subramanian · Sivakumar . V · [...] · Rajajeyaganthan Ramanathan

A high intense 464 nm excitable ZnWO4: Eu3+ red-emitting phosphor for warm white lighting applications was prepared by solid state reaction method by varying the dopant Eu3+ concentration. The crystalline purity and phase identification was confirmed and revealed by powder X-ray diffraction (PXRD) and Rietveld refinement analysis. The surface morphology of Zn1-xEuxWO4(x = 0, 0.01, 0.02, 0.03, 0.04 and 0.05) was...

Read more

View

Surfactants-assisted synthesis of ZnWO4 nanostructures: A view on photocatalysis, photoluminescence and electron density distribution analysis

Article

November 2019 · 359 Reads · 47 Citations

Export citation

Enhanced photocatalytic performance of pebble stone like CuMoO4 photocatalyst for the degradation of organic pollutant

Article

November 2022 · 38 Reads · 5 Citations

Physica B Condensed Matter

Lalitha Kamarasu · Ezhaveni Sathiyamoorthi · Satya Sree Nannapaneni · [...] · Naresh Kumar Katari

Hydrothermal synthesis of CuMoO4 photocatalyst for the photocatalytic degradation of methylene blue (MB) in the aqueous phase was performed under visible light illumination. The produced nanoparticle was characterized using X-ray Powder Diffraction (XRD), Fourier-transform infrared spectroscopy (FT-IR), Scanning Electron Microscopy (SEM), Ultraviolet–visible diffuse reflectance spectra (DRS-UV),...

Read more

View