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Development of CdS/TNTA nanocomposite to improve performance of simultaneous electrocoagulation-photocatalysis process for hydrogen production and ciprofloxacin elimination☆

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ABSTRACT

This study aimed to enhance the effectiveness of the simultaneous combination of electrocoagulation and photocatalysis processes by modifying the configuration of the photocatalyst. A heterojunction mechanism was developed by integrating CdS with a photocatalyst using a TiO_2 nanotube array (TNTA) [1]. This mechanism is designed to enhance photocatalytic efficiency by reducing electron-hole recombination. The successful synthesis of CdS/TNTA nanocomposite was confirmed using various characterization methods, including XRD, HRTEM, FESEM, UV–Vis DRS, PL, transient photocurrent, and XPS. The results showed that CdS/TNTA worked better than TNTA in a single photocatalysis process, achieving improved Ciprofloxacin (CIP) removal (7.9 % to 13.8 %) and hydrogen gas production (0.006 to 0.156 mmol/m^2plate). Simultaneously operating electrocoagulation and photocatalysis systems in the respective optimized settings resulted in significant enhancements. Hydrogen gas yield increased by 44 % (from 443 to 636 mmol/m^2 plate) compared to using only TNTA, while CIP removal improved from 79 % to 83 %. This study demonstrates that the synthesis of CdS/TNTA photocatalysts may be a promising approach to achieving high performance of hydrogen recovery while simultaneously removing CIP from wastewater.

1. Introduction

Pharmaceutical commodities are considered necessary due to the continuous growth of the human population, which intensifies health concerns. This demand significantly contributes to the generation of pharmaceutical waste. As a result, effective removal methods that can degrade the toxic properties of contaminants in the waste are required [2–5]. Several studies have been conducted on the treatment of liquid residue derived from pharmaceutical products, using chemical, physical, and biological methods [6,7]. An approach under investigation is electrocoagulation, which uses an electrochemical technique to produce adsorptive coagulants capable of removing dissolved contaminants from liquid waste.

The effectiveness of electrocoagulation is impeded by constraints, including the finite capacity of coagulants to adsorb and the inability to degrade these contaminants during the adsorption process [8,9]. Photocatalysis presents another viable option, using photon energy to initiate concurrent oxidation–reduction reactions on a substrate. The process is attractive due to its simplicity, cost-effectiveness, and simultaneous redox reactions. However, the limitations include photorecombination and the narrow spectrum of light required to activate photocatalysts [10,11].

Photocatalysis and electrocoagulation can remove dissolved pollutants from liquid waste and induce H^+ ion reduction reactions in water,

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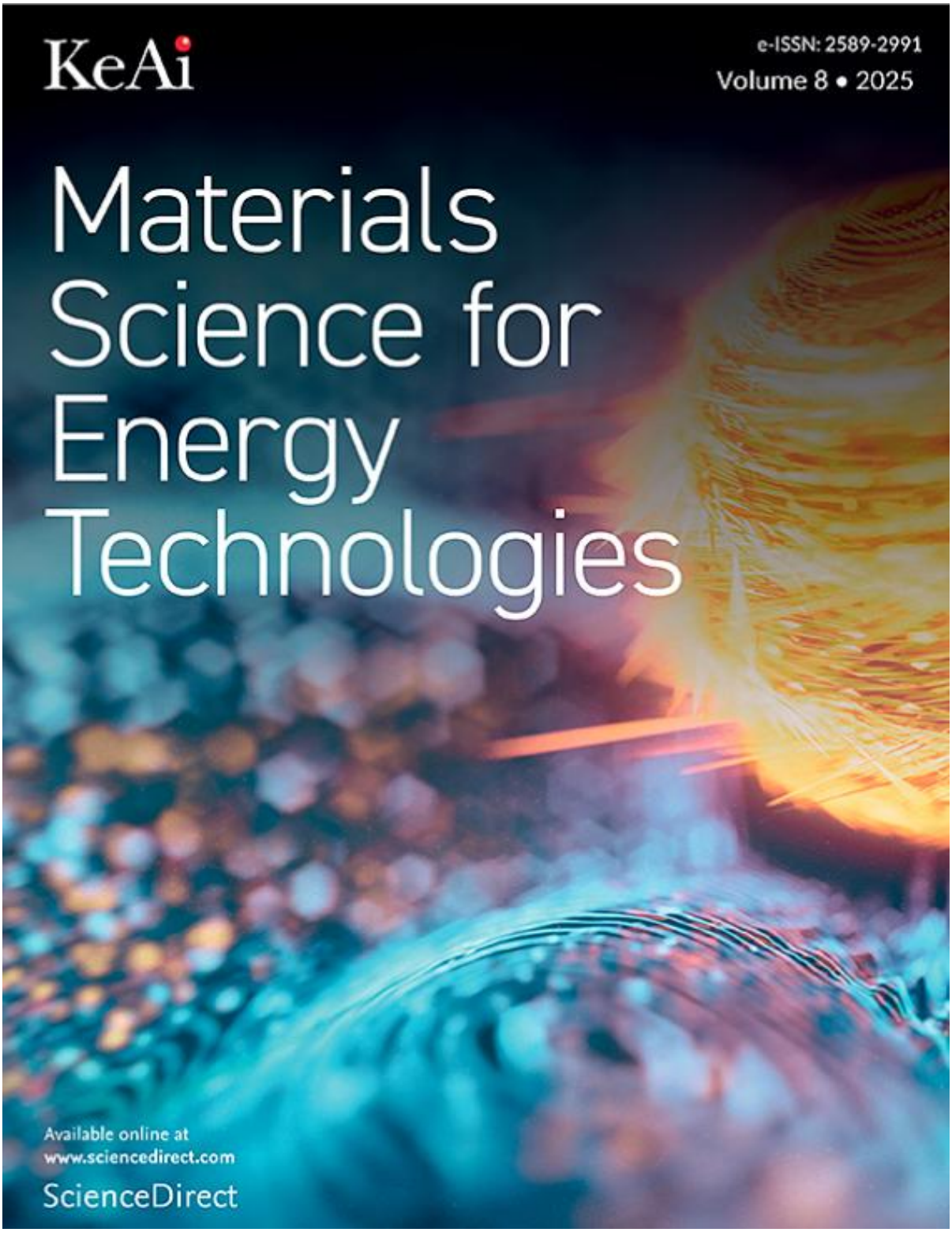

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Constraints in sustainable electrode materials development for solid oxide fuel cell: A brief review

Lukman Ahmed Omeiza, Asset Kabyshev, Kenzhebatyr Bekmyrza, Kairat A. Kuterbekov, ... Abul Kalam Azad

Pages 32-43

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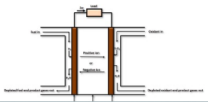

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A comprehensive review of the state-of-the-art of proton exchange membrane water electrolysis

Nurettin Sezer, Sertac Bayhan, Ugur Fesli, Antonio Sanfilippo

Pages 44-65

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Abstract

high current densities. Besides, PEMWE cells are characterized by a fast system response to fluctuating renewable power, enabling operations at broader partial power load ranges while consistently delivering high-purity hydrogen with low ohmic losses. Recently, much effort has been devoted to improving the efficiency, performance, durability, and economy of PEMWE cells. The research activities in this context include investigations of different cell component materials, protective coatings, and material characterizations, as well as the synthesis and analysis of new electrocatalysts for enhanced electrochemical activity and stability with minimized use of noble metals. Further, many modeling studies have been reported to analyze cell performance considering cell electrochemistry, overvoltage, and thermodynamics. Thus, it is imperative to review and compile recent research studies covering multiple aspects of PEMWE cells in one literature to present advancements and limitations of this field. This article offers a comprehensive review of the state-of-the-art of PEMWE cells. It compiles recent research on each PEMWE cell component and discusses how the characteristics of these components affect the overall cell performance. In addition, the electrochemical activity and stability of various catalyst materials are reviewed. Further, the thermodynamics and electrochemistry of electrolytic

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A review on green synthesis of TiO_2 nanoparticles: enhancing DSSC performance and exploring future opportunities

Muhammad, Nofrijon Sofyan, Akhmad Herman Yuwono, Donanta Dhaneswara

Pages 188-199

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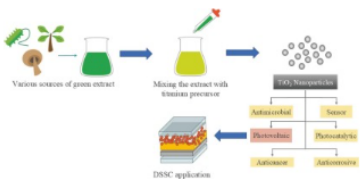

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Shahd Sefelnasr, Maryam Nooman AlMallahi, Mahmoud Elgendi

Pages 243-255

View PDF Article preview

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RETRACTED: Electrochemical applications of CdO-Co-ZnO nanocomposites, their synthesis and characterization reveal their multifunctional abilities

N. Rajkamal, K. Sambathkumar, K. Parasuraman, K. Bhuvaneswari, ... K. Kaviyarasu

Pages 1-12

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Abstract

3. Nearly identical elemental weight/atomic percentages across different samples are presented in the MSET article. Tables 2a (pure CdO), 2b (CdO/Co) and 2c (CdO/ZnO) show extremely similar Cd and O values (same Cd≈66–67 wt% and At%≈81–83), which is inconsistent with claims of doping and with the EDAX spectra claimed to be different. This indicates data reuse or fabrication from the old data.

4. There is extremely similar/duplicated methodology text and figure captions between the 2023 JKSUS paper and the MSET paper: the methods/SEM/EDX descriptions and figure captions are nearly identical in phrasing and structure, which suggests self-plagiarism and possibly that figures/text were recycled or refabricated in the new article.

Given the issues noted above, the Editor has lost confidence in the findings of the article and has determined that it

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Likkhasit Wannasen, Narong Chanlek, Wiyada Mongkolthanaruk, Sujittra Daengsakul, Supree Pinitsoontorn

Pages 13-23

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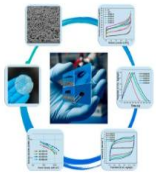

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Evaluation of the addition of cement ash to the PVA/TEOS/HCl gel electrolyte on the performance of aluminium air batteries

Firman Ridwan, Dandi Agusta, Muhammad Akbar Husin, Dahyunir Dahlan

Pages 24-31

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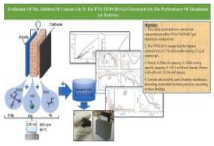

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Facile synthesis and electrochemical performance of bacterial cellulose/reduced graphene oxide/NiCo-layered double hydroxide composite film for self-standing supercapacitor electrode

A. Muhammad Afdhal Saputra, Marpongahtun, Andriayani, Diana Alemin Barus, ... Saharman Gea

Pages 66-81

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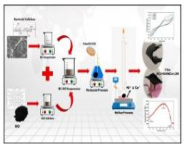

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Toyin Shittu, Aasif A. Dabbawala, Labeeb Ali, Abbas Khaleel, ... Mohammednoor Altarawneh

Pages 96-110

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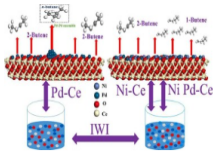

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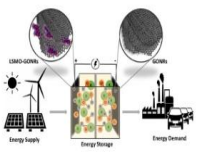

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Pages 111-120

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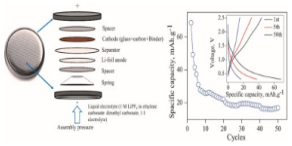

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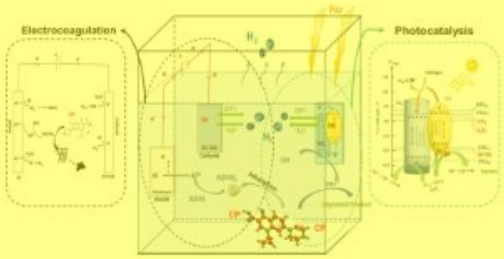

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Riki Subagyo, Garcelina Rizky Anindika, Afif Akmal Aufkani, Lei Zhang, ... Yuly Kusumawati

Pages 131-142

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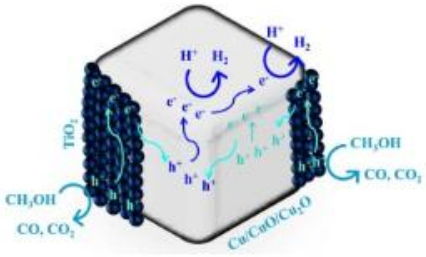

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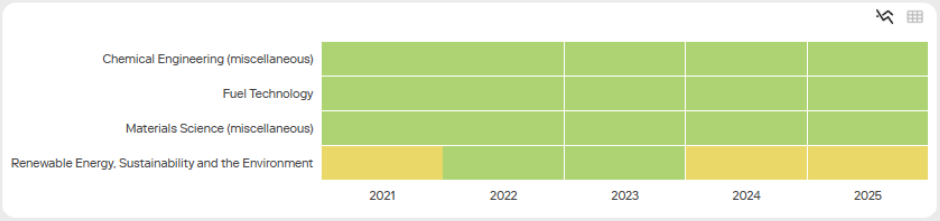

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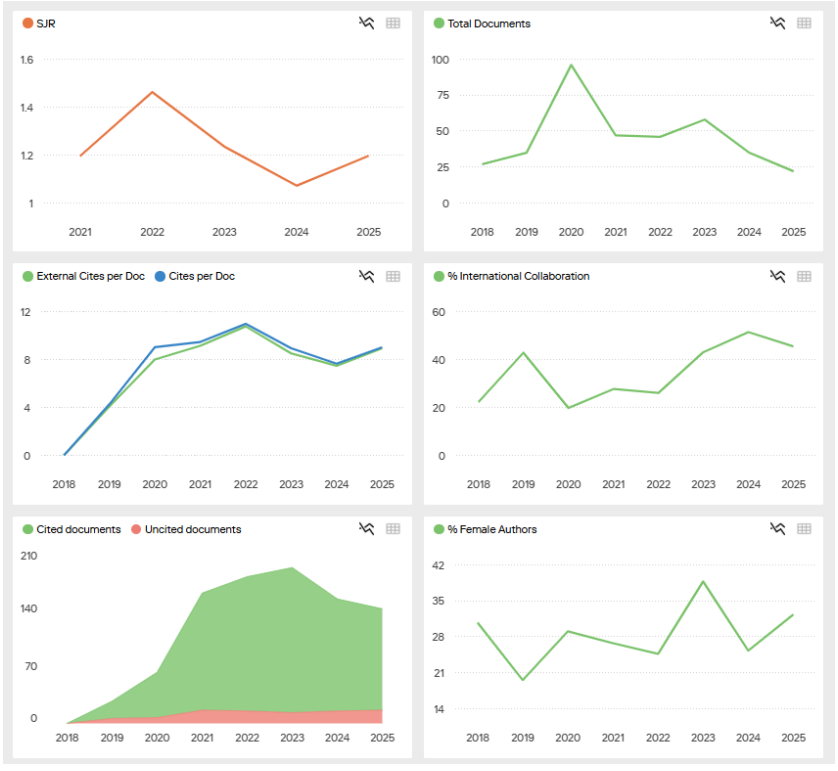

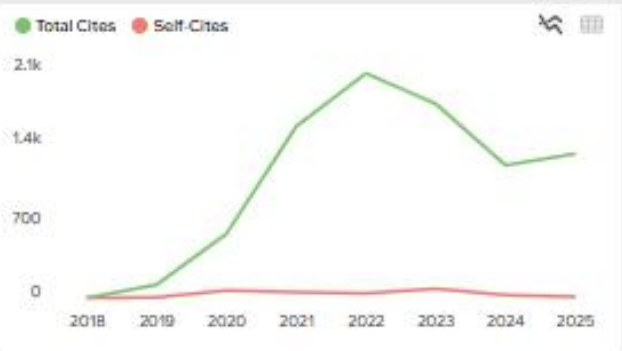
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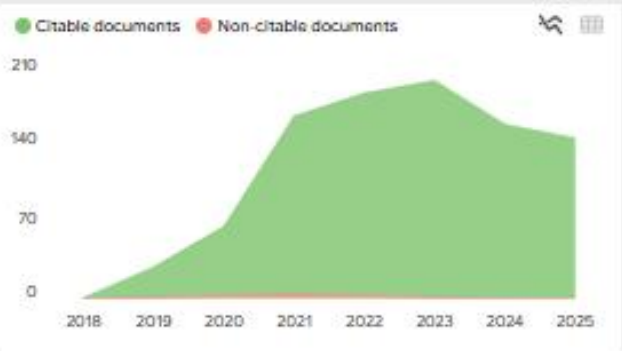
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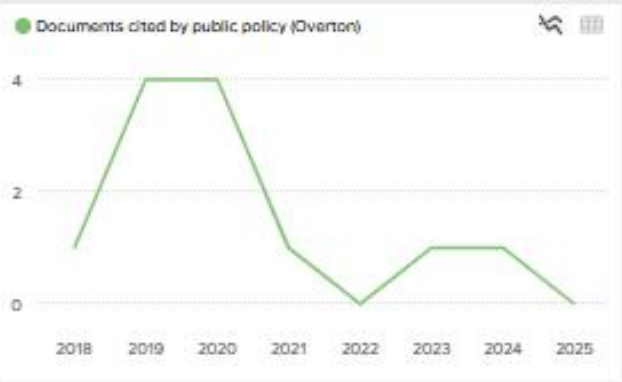
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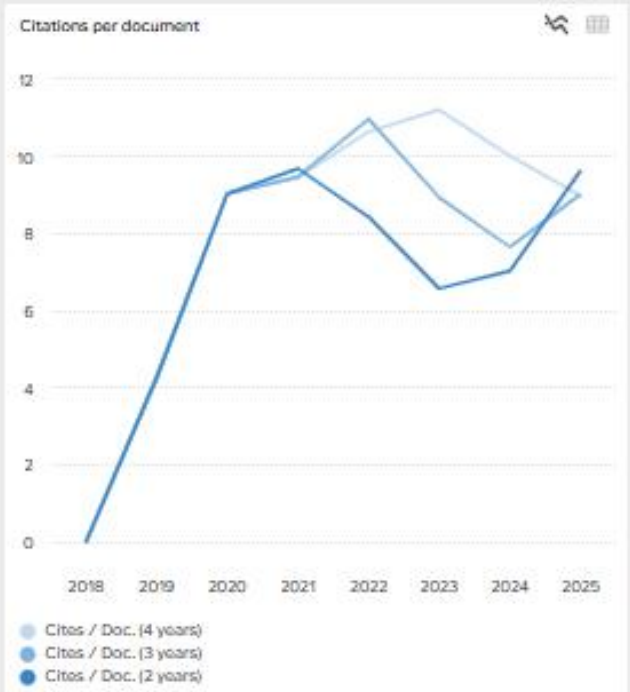
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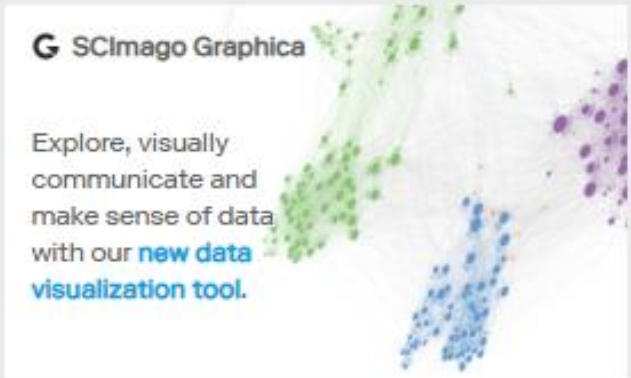
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Abstract

This study aimed to enhance the effectiveness of the simultaneous combination of electrocoagulation and photocatalysis processes by modifying the configuration of the photocatalyst. A heterojunction mechanism was developed by integrating CdS with a photocatalyst using a TiO_2 nanotube array (TNTA) [1]. This mechanism is designed to enhance photocatalytic efficiency by reducing electron-hole recombination. The successful synthesis of CdS/TNTA nanocomposite was confirmed using various characterization methods, including XRD, HRTEM, FESEM, UV–Vis DRS, PL, transient photocurrent, and XPS. The results showed that CdS/TNTA worked better than TNTA in a single photocatalysis process, achieving improved Ciprofloxacin (CIP) removal (7.9 % to 13.8 %) and hydrogen gas production (0.006 to 0.156 mmol/m^2plate). Simultaneously operating electrocoagulation and photocatalysis systems in the respective optimized settings resulted in significant enhancements. Hydrogen gas yield increased by 44 % (from 443 to 636 mmol/m^2 plate) compared to using only TNTA, while CIP removal improved from 79 % to 83 %. This study demonstrates that the synthesis of CdS/TNTA photocatalysts may be a promising approach to achieving high performance of hydrogen recovery while simultaneously removing CIP from wastewater. © 2025

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