

Biomimetic Solar Photocatalytic Reactor for Selective Oxidation of Aromatic Alcohols with Enhanced Solar-Energy Utilization

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Low utilization of solar energy remains a challenge that limits photocatalytic efficiency. To address this issue, this work proposes a bionic solar photocatalytic reactor (BSPR) for efficient selective oxidation of aromatic alcohols. A biomimetic phototropic hydrogel is prepared by coupling chlorine-doped polypyrrole (Cl-PPy) and poly(*N*-isopropyl acrylamide) (PNIPAm) to maximize light-harvesting efficiency automatically, allowing the BSPR to maintain high catalytic levels throughout the day. Molecular dynamics simulations are used to unveil the understanding of the fast photoresponsive behavior of Cl-PPy/PNIPAm from a molecular level, while COMSOL simulations are conducted to follow the macroscopically phototropic mechanism of BSPR. Attributing to the existence of PdS/S vacancies riched ZnIn₂S₄ nanocomposite in the top flower-shaped hydrogel, the BSPR displays a special function for efficiently photocatalytic oxidation of aromatic alcohols under solar illumination (yield of 4-methoxybenzaldehyde: 479.5 $\mu\text{mol g}^{-1} \text{h}^{-1}$; selectivity: 68.8%). Two possible reaction pathways are identified as follows: photogenerated holes can attract aromatic alcohols directly and generate aromatic aldehydes; photoexcited electrons oxidize O₂ to $\cdot\text{O}_2^-$ can also react with the adsorbed aromatic alcohol. This study presents a promising paradigm that explores opportunities for enhanced utilization of light energy, offering a novel approach to maximize its efficiency in practical applications.

1. Introduction

The self-adaption abilities of biological systems in nature (e.g., mimosa pedica, sunflower, flytrap, etc.) are promoting the

emergence of various smart materials,^[1–4] that can change their structures, properties, and functions autonomously to respond to the innocuous stimuli (e.g., heat, pH, light, electricity, etc.) in their surrounding environments. In particular, light-responsive smart materials allow flexible manipulations at remote distances,^[5–7] which are mainly driven by the intelligent composites of photothermal absorber and temperature-sensitive material for efficient photothermal conversion and thermally induced phase transition, respectively.^[8–9] For the fabrication of these intelligent composites, the main task is to find suitable temperature-sensitive materials that can satisfy the requirements of diverse temperature ranges. Up to now, the most commonly used temperature-responsive materials include poly(*N*-isopropyl acrylamide) (PNIPAm), 2(dimethylamino)ethyl methacrylate, 4-(3-Acryloyloxypropyloxy)-benzoicure 2methyl-1,4-phenylester), and some other composites.^[10–12] Among them, PNIPAm-based hydrogel can undergo a heat-induced conformational transition from a water-soluble coiled structure to a water-insoluble globular structure above its lower critical solubility temperature (LCST, $\approx 32^\circ\text{C}$), resulting in the massive loss of confined water in the network of PNIPAm-based hydrogel with its notable volume reduction and

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The ORCID identification number(s) for the author(s) of this article can be found under <https://doi.org/10.1002/adfm.202311214>

DOI: 10.1002/adfm.202311214

Solar Power Applications Alcohols

Julian Chela-Flores, François Raulin



Solar Power Applications Alcohols:

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Task Force on Alcohol Fuels,1978 **Chemical Evolution: Physics of the Origin and Evolution of Life** Julian Chela-Flores,François Raulin,2012-12-06 Leading researchers in the area of the origin and evolution of life in the universe contributed to Chemical Evolution Physics of the Origin and Evolution of Life This volume provides a review of this interdisciplinary field In 35 chapters many aspects of the origin of life are discussed by 90 authors with particular emphasis on the early paleontological record physical chemical biological and informational aspects of life s origin instrumentation in exobiology and system exploration the search for habitable planets and extraterrestrial intelligent radio signals This book contains the proceedings of the Fourth Trieste Conference on Chemical Evolution that took place in September 1995 in which scientists from a wide geographical distribution joined in a Memorial to Cyril Ponnampereuma who was a pioneer in the field of chemical evolution the origin of life and exobiology and also initiated the Trieste Conferences on Chemical Evolution and the Origin of Life This fourth Conference was therefore dedicated to his memory Audience Graduate students and researchers in the many areas of basic earth and life sciences that contribute to the study of chemical evolution and the origin of life **Hydrogen Production, Transport, and Storage** 3 M. C. Williams,2009-10 The research articles included

in this issue of ECS Transactions were originally presented during the 215th meeting of The Electrochemical Society in San Francisco CA from May 24 to 29 2009 and are key to furthering the movement to the hydrogen economy enabled by fuel cells

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Table of Contents Solar Power Applications Alcohols

1. Understanding the eBook Solar Power Applications Alcohols
 - The Rise of Digital Reading Solar Power Applications Alcohols
 - Advantages of eBooks Over Traditional Books
2. Identifying Solar Power Applications Alcohols
 - Exploring Different Genres
 - Considering Fiction vs. Non-Fiction
 - Determining Your Reading Goals
3. Choosing the Right eBook Platform
 - Popular eBook Platforms
 - Features to Look for in an Solar Power Applications Alcohols
 - User-Friendly Interface
4. Exploring eBook Recommendations from Solar Power Applications Alcohols
 - Personalized Recommendations
 - Solar Power Applications Alcohols User Reviews and Ratings
 - Solar Power Applications Alcohols and Bestseller Lists
5. Accessing Solar Power Applications Alcohols Free and Paid eBooks
 - Solar Power Applications Alcohols Public Domain eBooks
 - Solar Power Applications Alcohols eBook Subscription Services
 - Solar Power Applications Alcohols Budget-Friendly Options
6. Navigating Solar Power Applications Alcohols eBook Formats
 - ePub, PDF, MOBI, and More
 - Solar Power Applications Alcohols Compatibility with Devices
 - Solar Power Applications Alcohols Enhanced eBook Features
7. Enhancing Your Reading Experience
 - Adjustable Fonts and Text Sizes of Solar Power Applications Alcohols
 - Highlighting and Note-Taking Solar Power Applications Alcohols
 - Interactive Elements Solar Power Applications Alcohols
8. Staying Engaged with Solar Power Applications Alcohols

- Joining Online Reading Communities
- Participating in Virtual Book Clubs
- Following Authors and Publishers Solar Power Applications Alcohols
- 9. Balancing eBooks and Physical Books Solar Power Applications Alcohols
 - Benefits of a Digital Library
 - Creating a Diverse Reading Collection Solar Power Applications Alcohols
- 10. Overcoming Reading Challenges
 - Dealing with Digital Eye Strain
 - Minimizing Distractions
 - Managing Screen Time
- 11. Cultivating a Reading Routine Solar Power Applications Alcohols
 - Setting Reading Goals Solar Power Applications Alcohols
 - Carving Out Dedicated Reading Time
- 12. Sourcing Reliable Information of Solar Power Applications Alcohols
 - Fact-Checking eBook Content of Solar Power Applications Alcohols
 - Distinguishing Credible Sources
- 13. Promoting Lifelong Learning
 - Utilizing eBooks for Skill Development
 - Exploring Educational eBooks
- 14. Embracing eBook Trends
 - Integration of Multimedia Elements
 - Interactive and Gamified eBooks

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