

**Towards Sustainable and Green Hydrogen  
Production by Photocatalysis: Insights into Design  
and Development of Efficient Materials (Volume 2)**

**Printed from e-media with permission by:**

Curran Associates, Inc.  
57 Morehouse Lane  
Red Hook, NY 12571

Email: [curran@proceedings.com](mailto:curran@proceedings.com)  
Web: [www.proceedings.com](http://www.proceedings.com)

CURRAN ASSOCIATES INC.  
**proceedings**  
.com

The paper used in this publication meets the minimum requirements of American National Standard for Information Sciences—Permanence of Paper for Printed Library Materials, ANSI Z39.48n1984. | ISBN 9781713898818 (pod)

Copyright © 2024 American Chemical Society

All Rights Reserved. Reprographic copying beyond that permitted by Sections 107 or 108 of the U.S. Copyright Act is allowed for internal use only, provided that a per-chapter fee of \$40.25 plus \$0.75 per page is paid to the Copyright Clearance Center, Inc., 222 Rosewood Drive, Danvers, MA 01923, USA. Republication or reproduction for sale of pages in this book is permitted only under license from ACS. Direct these and other permission requests to ACS Copyright Office, Publications Division, 1155 16th Street, N.W., Washington, DC 20036.

The citation of trade names and/or names of manufacturers in this publication is not to be construed as an endorsement or as approval by ACS of the commercial products or services referenced herein; nor should the mere reference herein to any drawing, specification, chemical process, or other data be regarded as a license or as a conveyance of any right or permission to the holder, reader, or any other person or corporation, to manufacture, reproduce, use, or sell any patented invention or copyrighted work that may in any way be related thereto. Registered names, trademarks, etc., used in this publication, even without specific indication thereof, are not to be considered unprotected by law.

PRINTED IN THE UNITED STATES OF AMERICA

# Contents

<b>Preface .....</b>	<b>ix</b>
<b>1. Production of Green Hydrogen through Photocatalysis.....</b>	<b>1</b>
Manoj Kumar, Neeraj Kumar Singh, Ruplappara Sharath Kumar, and Rajesh Singh	
<b>2. Recent Advancements in Scalable Hydrogen Generation: An Integrated Approach of Experiments, Computation, and Machine Learning .....</b>	<b>25</b>
Ruchi Agarwalla, Riya Mudoi, Unnati Bora, Jyotirmoy Deb, Madhulekha Gogoi, and Lakshi Saikia	
<b>3. Photocatalysis-Derived Biomass Conversion for Green Hydrogen Production.....</b>	<b>47</b>
Manjinder Singh, Dun Chan Cha, Hayoung Kim, Jaejun Park, Saerona Kim, Chang Geun Yoo, Gyu Leem, and Seunghyun Lee	
<b>4. Photocatalytic Water Splitting for Production of Green Hydrogen Using Metal Oxide Nanoparticles.....</b>	<b>79</b>
Kuldeep Kumar, Shweta Kaushal, Ravi Kumar, Pankaj Kumar, Nikesh Thakur, and Naveen Thakur	
<b>5. TMDs as Photocatalysts for Green Hydrogen Production .....</b>	<b>107</b>
Saman Shaheen, Iqra Sadiq, Syed Asim Ali, and Tokeer Ahmad	
<b>6. Advances in MXenes-Based Photocatalysts for Hydrogen Evolution: Fundamentals, Synthesis, and Applications .....</b>	<b>145</b>
Sanjay Kumar, Astha Tripathi, Maku Moronshing, and Pratibha Kumari	
<b>7. MXene-Based Photocatalyst for Efficient H<sub>2</sub> Evolution.....</b>	<b>173</b>
Hushan Chand	
<b>8. Advances in Design and Development of g-C<sub>3</sub>N<sub>4</sub> Based Photocatalysts for Sustainable Hydrogen Production.....</b>	<b>209</b>
Narinder Singh, Akshay Thakur, and Ashish Kumar	
<b>9. Bismuth Oxyhalide Photocatalysts: Pioneering Efficiency in Hydrogen Generation ...</b>	<b>241</b>
Bhawna, Ritika Sharma, Sanjeev Kumar, Vijay Kumar Vishvakarma, Garima Pandey, and Vinod Kumar	
<b>10. Titanium-Dioxide-Based Photocatalysts for Efficient Hydrogen Production.....</b>	<b>255</b>
Ajay Kumar, Irwing Ramirez, Priyanka Choudhary, Lalita Sharma, Ashutosh Bhagurkar, Rohit Rana, and Kuldeep Kumar	

<b>11. Recent Advances in ZnO-Based Photocatalysts for Sustainable Hydrogen Production</b>	<b>279</b>
Akshay Thakur, Pankaj Kumar, Ashish Kumar, and Lakhveer Singh	
<b>12. Cutting-Edge Sulfide-Based Transition Metals as Photocatalysts for Exceptional Hydrogen Production.....</b>	<b>295</b>
Vempuluru Navakoteswara Rao, M V Shankar, and Jun-Mo Yang	
<b>13. Sulfide-Based Photocatalysts for Efficient H<sub>2</sub> Production .....</b>	<b>333</b>
Rijith S, Akhila M, and Sumi V S	
<b>14. Recent Trends in Z-Scheme Photocatalysis for Green H<sub>2</sub> Production .....</b>	<b>363</b>
Subha N, Santosh S. Patil, Ravi Sankar A, and Lakshmana Reddy Nagappagari	
<b>15. Advancement of S-Scheme Heterostructure Photocatalysts for Efficient Hydrogen Evolution and Sustainable Development.....</b>	<b>391</b>
MD Shouquat Hossain and Hui Xu	
<b>16. Production of Green Hydrogen through Metal-Based Photocatalysts .....</b>	<b>425</b>
Muhammad Yahya Tahir, Sadia Muzammal, Shafaqat Ali, ElSayed M. Tag El Din, and Muammad Sufyan Javed	
<b>17. Nanostructured Materials for Enhanced Photocatalytic Hydrogen Evolution.....</b>	<b>451</b>
Hushan Chand and Saneel Kumar	
<b>18. Graphene-Based Efficient Photocatalytic Materials for Hydrogen Generation .....</b>	<b>465</b>
Divya Thakur, Vandna Thakur, Neha Singh, Manish Kumar, and Maheshwar S. Thakur	
<b>19. Recent Advances in Defect-Engineered Materials for Photocatalytic H<sub>2</sub> Production ..</b>	<b>497</b>
Manjula Sharma, Asha Kumari, Aditi Thakur, Renu Bala, and Vandna Kumari	
<b>20. Effect of External Electric/Magnetic Field on Photocatalysis for Green Hydrogen .....</b>	<b>515</b>
Anirban Mukherjee and Dibyendu Ghosh	
<b>Editor's Biography .....</b>	<b>539</b>

### Indexes

<b>Author Index.....</b>	<b>543</b>
<b>Subject Index .....</b>	<b>545</b>