



能源及環境學院
SCHOOL OF ENERGY
AND ENVIRONMENT

Sunlight-driven Water Splitting for **Clean** Hydrogen Production

Hydrogen Economy Conference (HEC)

氢能經濟會議

23rd November 2020

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City University of Hong Kong

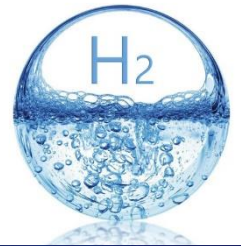
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Editor

Journal of Materials Science: Materials in Electronics

(Springer Publisher)

H₂ Development





METI
Ministry of Economy, Trade and Indus

Formulation of a New Strategic Roadmap for Hydrogen and Fuel Cells

March 12, 2019 Agency for Natural Resources and Energy

Japan

HYDROGEN ROADMAP EUROPE

Europe

A SUSTAINABLE PATHWAY FOR THE EUROPEAN ENERGY TRANSITION

News

Korean Government Announces Roadmap to Become the World Leader in the Hydrogen Economy

Korea

Hydrogen scaling up

USA



HONG KONG'S CLIMATE ACTION PLAN 2030+

Hong Kong

National Hydrogen Roadmap

Australia

中国氢能联盟
CHINA HYDROGEN ALLIANCE

China

中国氢能及燃料电池产业
白皮书
(2019版)

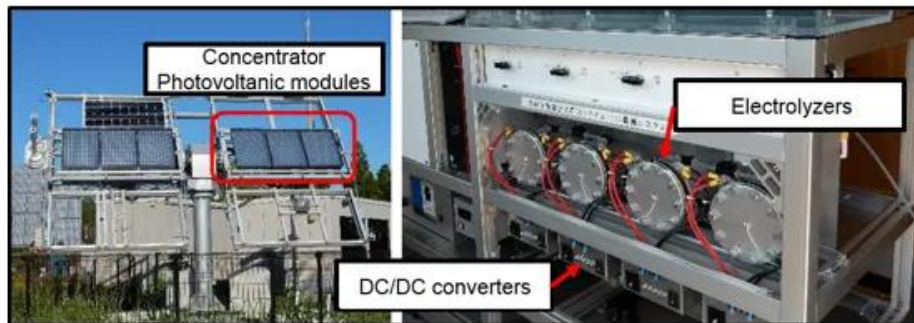
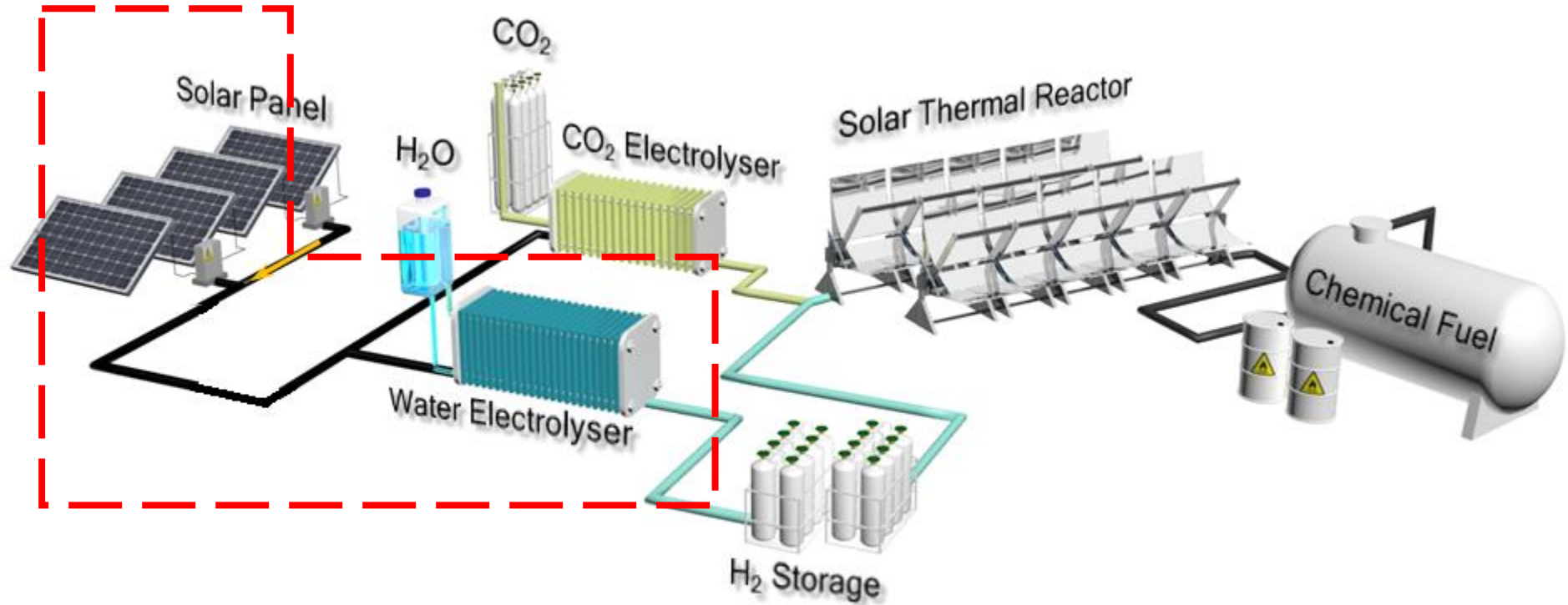
中国氢能联盟成立500天献礼

6月26日 中国氢能白皮书 重磅发布

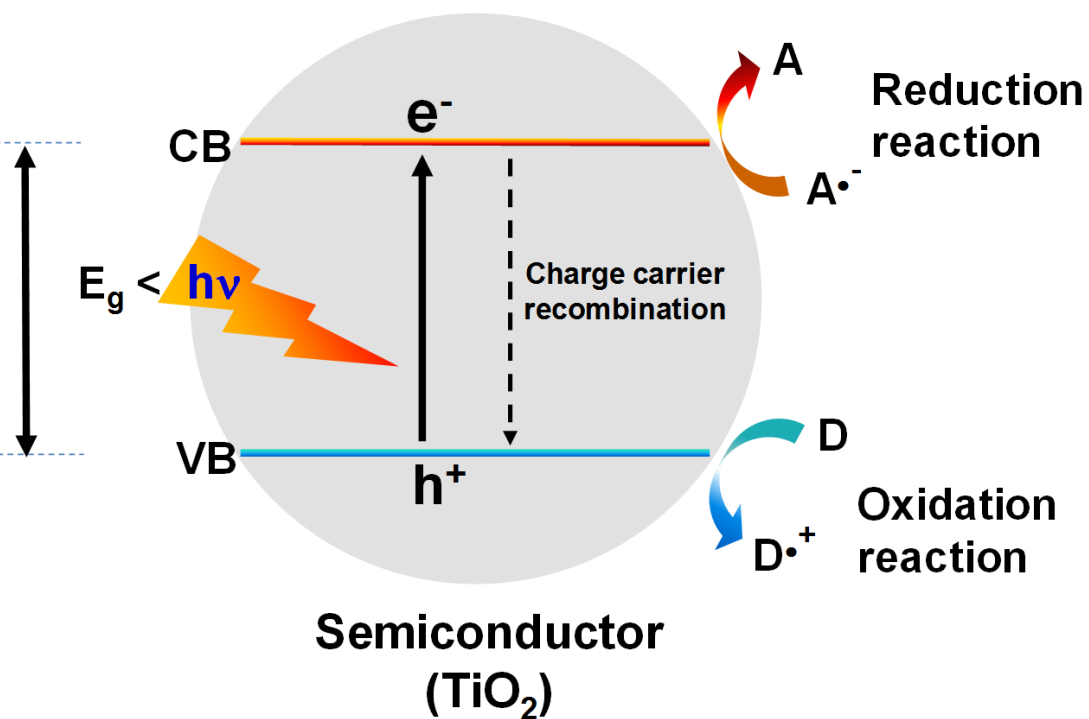
一幅 中国氢能发展的“趋势图”
一扇 观察氢能产业路线的新窗

用数据和事实展现中国氢能之力
以行动和倡议激发未来能源变革

Sunlight-driven Hydrogen Production from water



Main Research Branches in Photocatalysis



■ Environmental Application (Airborne & Aqueous based)

■ Fine Organic Synthesis

■ Solar Energy Conversion

Currently the Focus

- CO₂ reduction/conversion
- Water Splitting
- Hydrogen Generation
- Solar Cells



光化學空氣 殺菌除味機

Photolysis Air Sterilization Deodorizer



利用光化學的技術，
改善室內空氣質素，
去除異味、殺菌，
並控制臭氧至近乎零排放量，
絕對符合最嚴格的
美國安全標準（低於0.05ppm）

Actino
chemistry

首部由香港人研發，
應用光化學原理之空氣淨化機

產品特點

- 無需更換過濾網，也不會因為使用飽和失效之過濾網而產生二次污染。
- 配備人工智能系統及探測器監控空氣的污染程度，並可通過藍牙與AirStatus Apps連接。
- UV管壽命約為16,000小時，較其他技術耐用，耗電量低。
- 更換燈管時間約為兩年，並由光化環科提供一年免費原廠保養服務。
- 配備傾斜安全系統，當機身傾斜超過30度時會自動斷電。
- 設有大風、自動及睡眠模式。
- 設計簡潔美觀，運作寧靜。
- 設有直立式設計和掛牆式設計兩種，迎合不同需要。
- CADR值為305m³/h，快速減低空氣中污染物的濃度。
- 可降低空氣中PM2.5及PM10之濃度。
- 適用面積為22m²。
- 機身尺寸：278mm(長) X 278mm(闊) X 598mm(高)
- 工作溫度：0度 — 50度(攝氏)
- 機身淨重：8kg
- 最大耗電量：150W



Website



納米光觸媒消毒



持續有效
三個月

購置日期：
年 月

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Towngas

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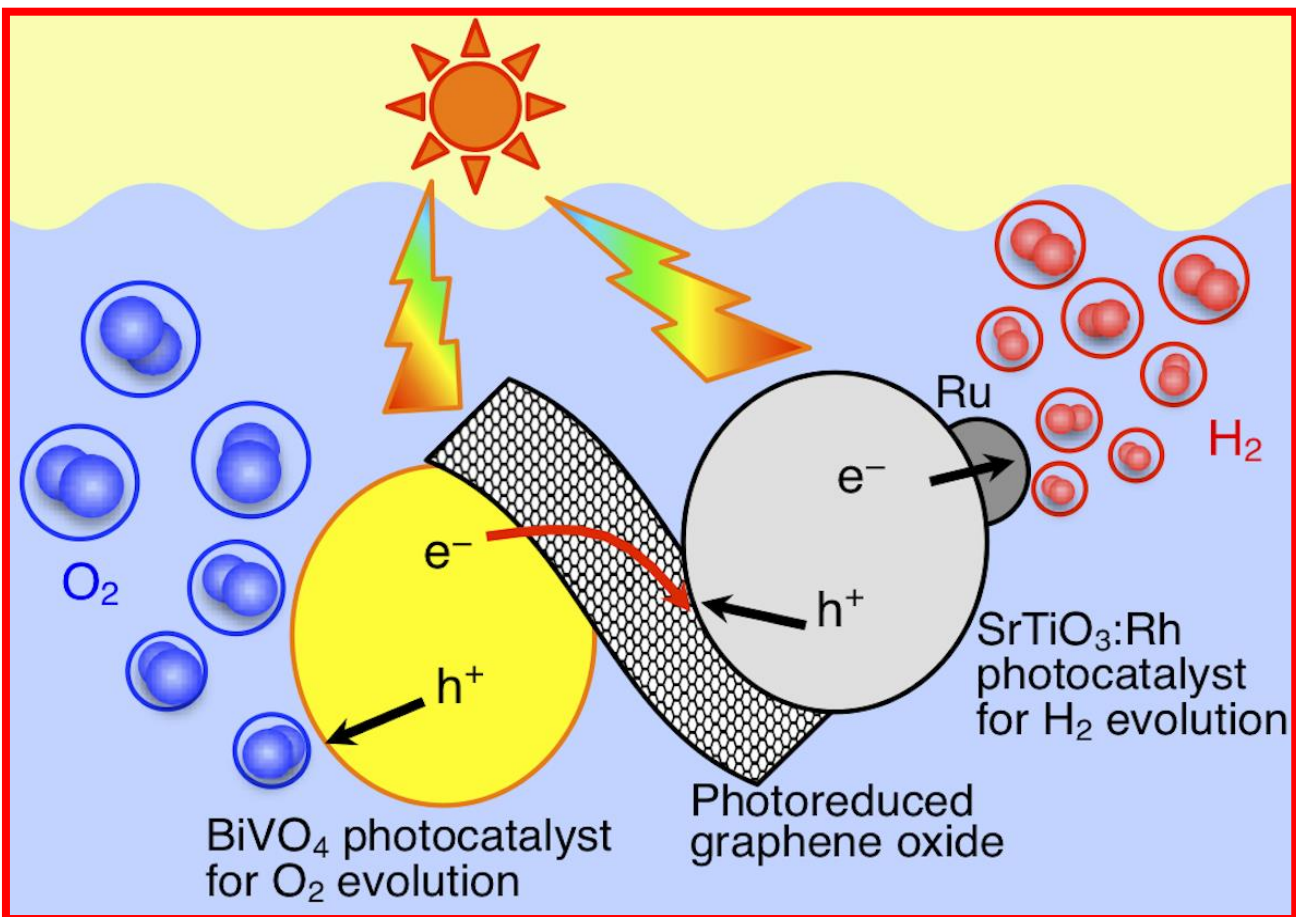


Actino Tech



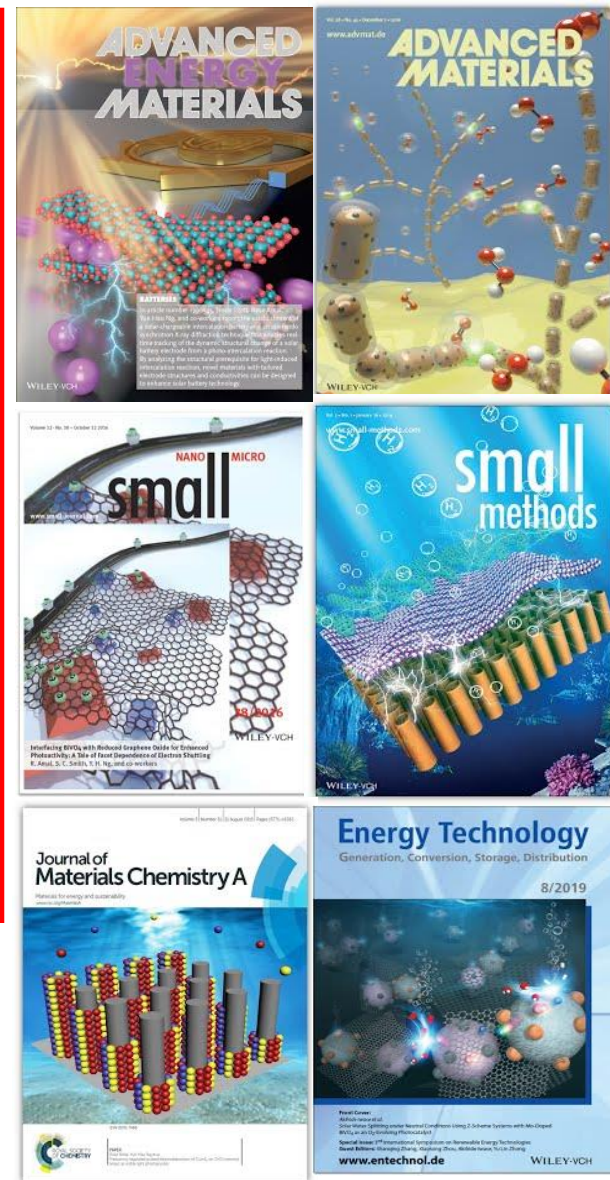
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Core Principle of Artificial Photosynthesis



Chem. Soc. Rev. **2019**, 48 (5), 1255
Chem. Rev. **2016**, 116 (12), 7159
Adv. Mater. **2020**, DOI:10.1002/adma.201904717
Adv. Mater. **2019**, 31 (8), 1807204
Adv. Mater. **2016**, 28 (45), 9949 (Journal Cover)
Adv. Mater. **2007**, 19 (4), 597
Adv. Energy Mater. **2017**, 7 (19), 1700545 (Journal Cover)
Adv. Energy Mater. **2017**, 7 (9), 1602325
Angew. Chem. Int. Ed. **2019**, DOI:10.1002/anie.201909014
Angew. Chem. Int. Ed. **2018**, 57 (41), 13613

J. Am. Chem. Soc. **2016**, 138 (32), 10260
J. Am. Chem. Soc. **2015**, 137 (2), 604
J. Am. Chem. Soc. **2012**, 134 (9), 4393
J. Am. Chem. Soc. **2011**, 133 (29), 11054
ACS Catal. **2018**, 8 (8), 7158
ACS Catal. **2016**, 6 (12), 8021
Energy Environ. Sci. **2012**, 5 (11), 9307
J. Mater. Chem. A **2016**, 4 (18), 6964
J. Mater. Chem. A **2015**, 3 (31), 15876 (Journal Cover)
SMALL **2016**, 12 (38), 5295 (Journal Cover)



Crystal Facet Selective Redox Reactions on Monoclinic BiVO_4

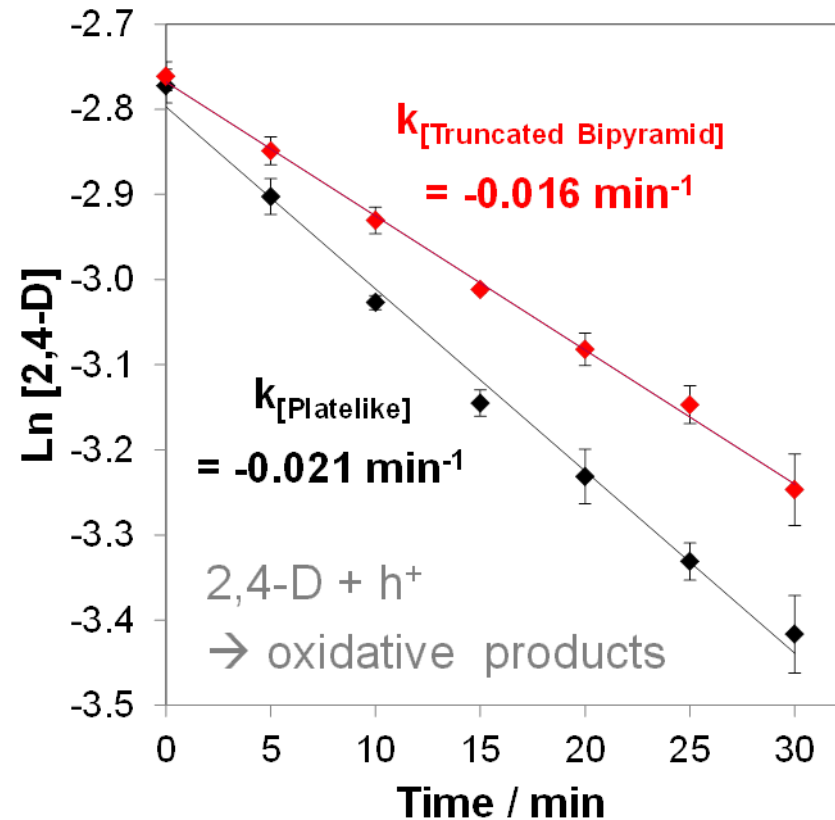


Li, Rengui, et al. "Spatial separation of photogenerated electrons and holes among {010} and {110} crystal facets of BiVO_4 ." *Nature communications* 4 (2013): 1432.

Photooxidation Tests

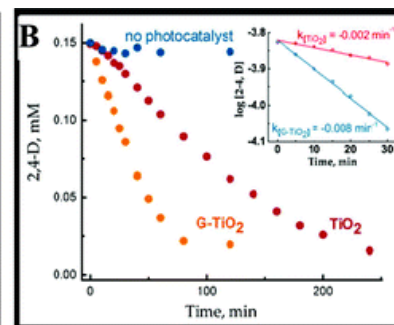
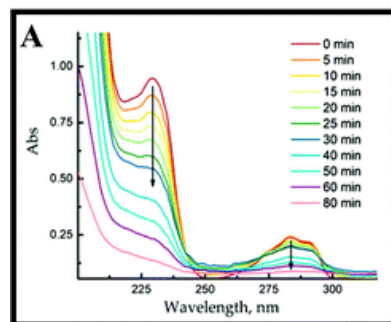
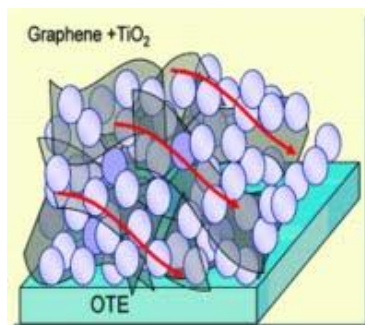


2,4-D Degradation in Aerated Solution

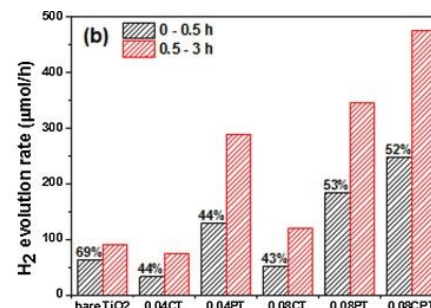
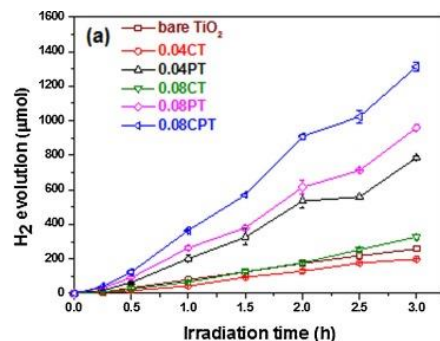
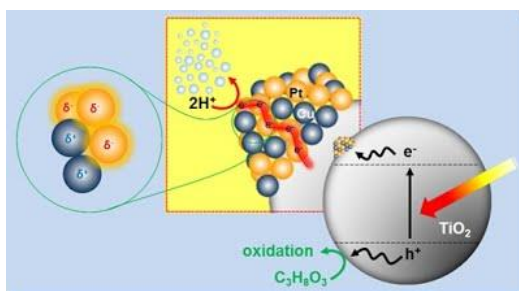


Transforming waste into.....

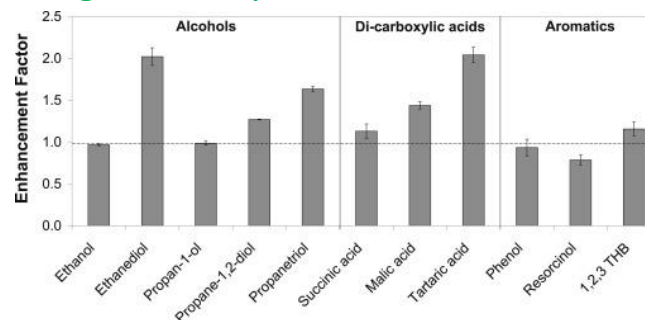
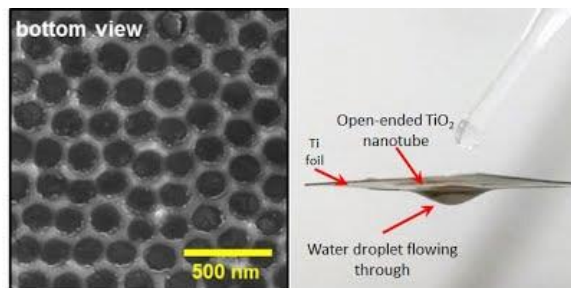
2, 4 – dichlorophenoxyacetic acid (2, 4-D) (Herbicide)

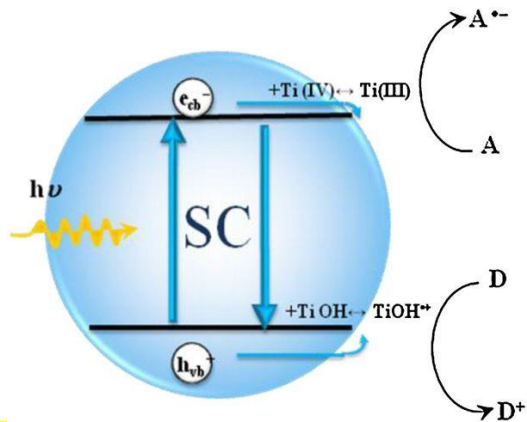


Glycerol (waste from biofuel/biodiesel production)

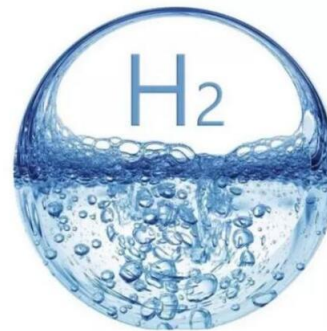
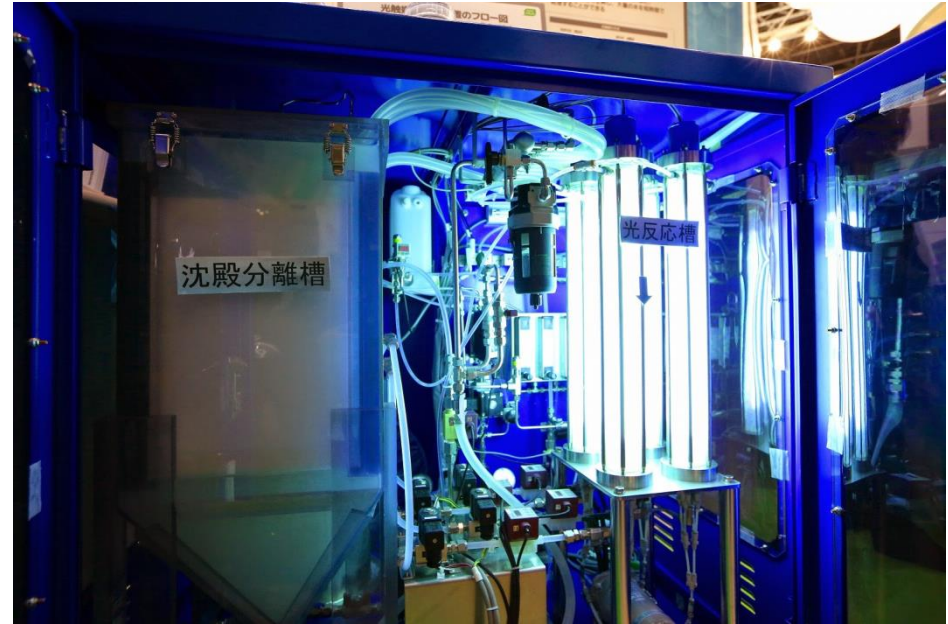


Organic compounds





High Efficient Photocatalytic H_2 generation from organic waste

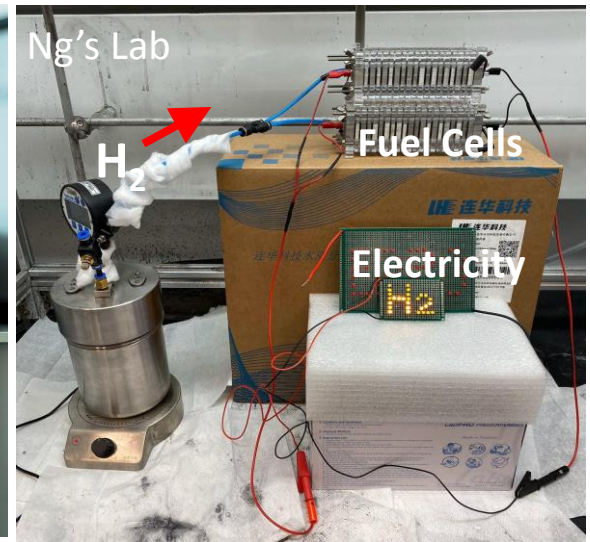


Renewable Clean Energy from Waste

Highly concentration organic waste water



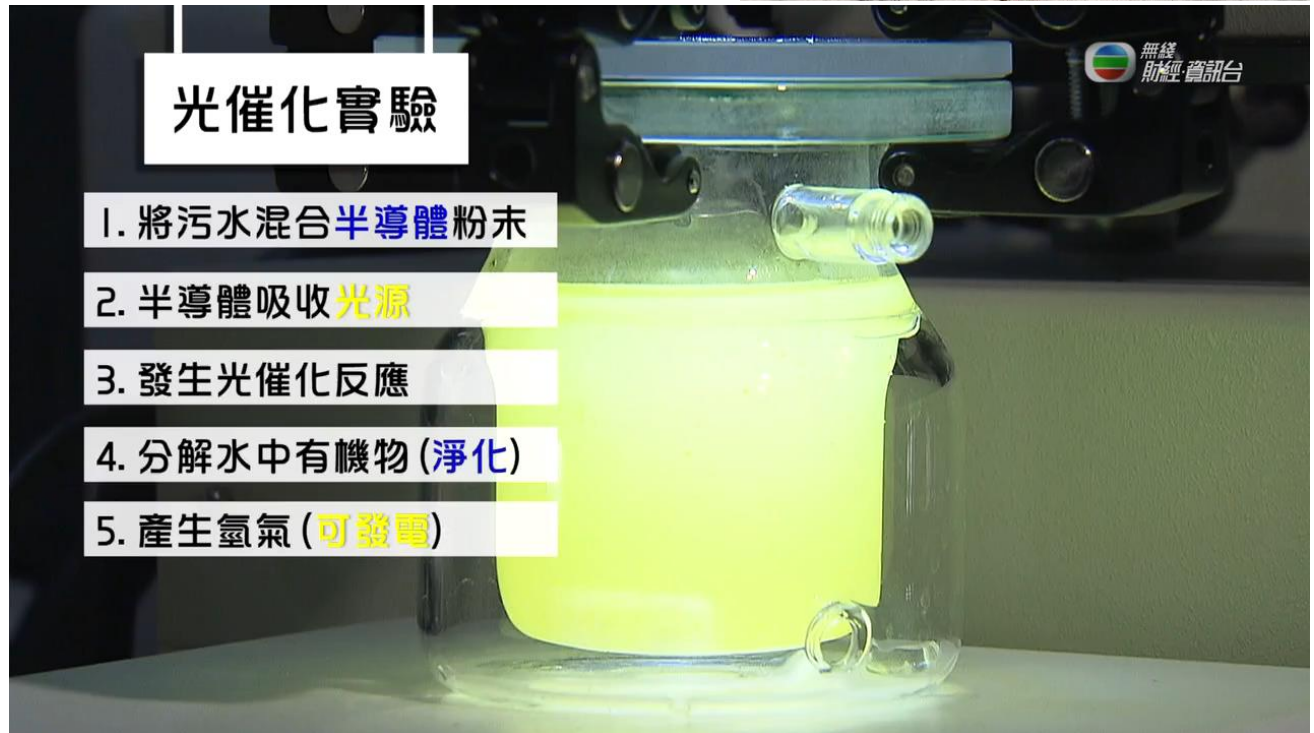
Feasibility



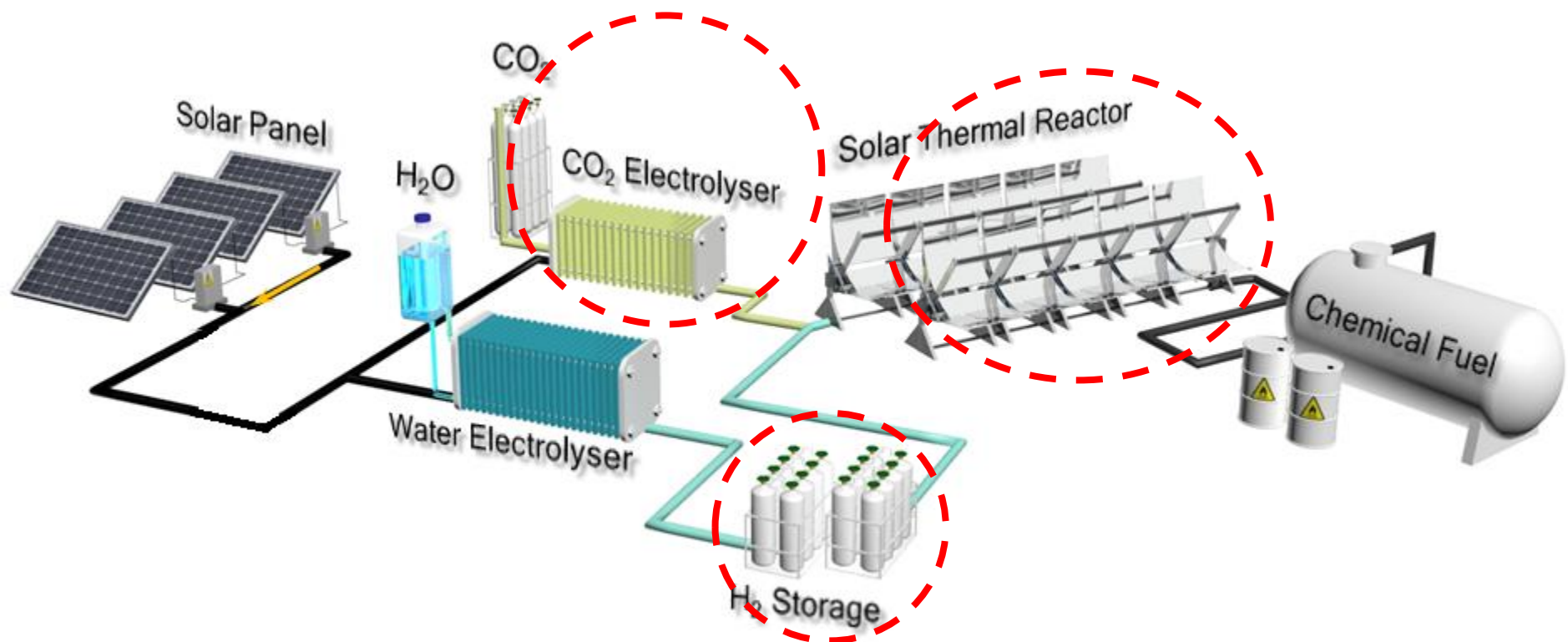
It Works!

光催化實驗

1. 將污水混合半導體粉末
2. 半導體吸收光源
3. 發生光催化反應
4. 分解水中有機物 (淨化)
5. 產生氫氣 (可發電)



無線財經資訊台



Thank you



香港城市大學
City University of Hong Kong



**Asia-Pacific
Economic Cooperation**

**Research Grants Council
of Hong Kong**
香港 研究資助局



Australian Government
Australian Research Council

機電工程署
EMSD



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MEXT
MINISTRY OF EDUCATION,
CULTURE, SPORTS,
SCIENCE AND TECHNOLOGY-JAPAN

HKPC
Hong Kong Productivity Council
香港生產力促進局

**Australian
Synchrotron**



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