子項目三：新型光能採集之開發
Subtopic 3: Alternative Solar Technologies

研發微纖維紅磷從水中高效製造新型潔淨能源（氫氣）
Using micro-fibrous Red Phosphorus to Produce Clean Fuel (Hydrogen) from Water with High Efficiency

余濟美教授 Professor Jimmy Yu
香港中文大學化學系 Department of Chemistry, CUHK
Email: jimyu@cuhk.edu.hk

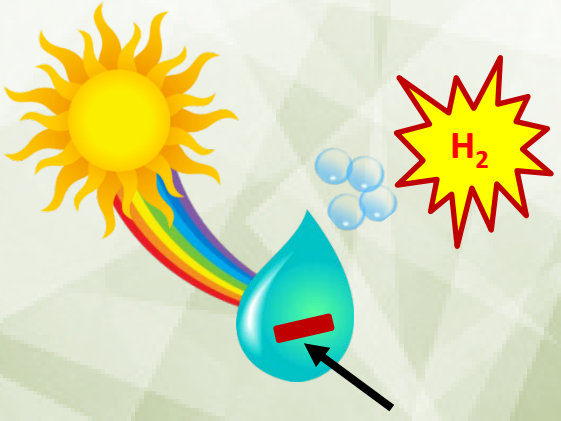
簡介Abstract

余濟美教授最近的研究發現，只要在水中加入一種「神秘成分」，一起暴露在陽光下，就能製造潔淨燃料。關鍵成分就是紅磷。在陽光下，紅磷可把水分解，產生氣泡狀的氫 ── 一種潔淨燃料。研究發現，一種特別類型的「微纖維紅磷」比其他種類的紅磷、甚至比其他光催化劑，能更有效從水中生產氫氣，同時成本也更低。

The research team of Prof. Jimmy Yu found a way to create clean fuel by simply exposing water (laced with a secret ingredient) to sunlight. The key ingredient is red phosphorus. Their research discovered that the hydrogen yield by a particular type of red phosphorus (micro-fibrous phosphorus) is much higher than that of other types, and is the highest among elemental photocatalysts at a much lower cost.

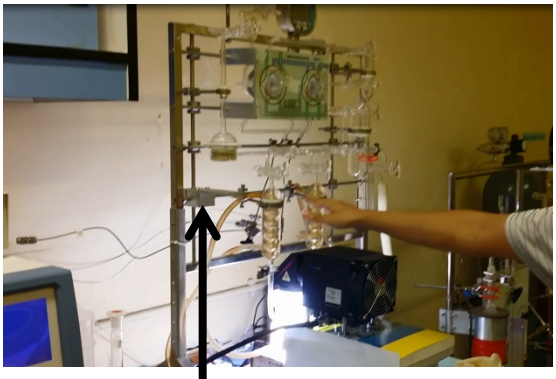
針對問題 Problem to be Solved

隨着人類對能源需求的快速增長以及使用傳統化石燃料所導致的全球氣候惡化，全球正為尋求潔淨能源而努力。光催化劑的運作，就如葉綠素之於植物，它吸收光的能源，產生化學反應並轉化為能源，過程就是一種人工的光合作用。可用作光催化劑的材料，沒有數千也有數百種，但大都是重金屬氧化合物，昂貴且製造過程複雜，常要用上稀有元素來提高效能。因此化學家一直尋求有相同功能的單一元素。紅磷蘊藏量豐富，取之不竭。它藏在地殼中，開採也容易。氫這種潔淨能源的容量很高，能比其他化學燃料產生更大能量。生產過程完結後，餘下的副產品只有水，並無有毒氣體。



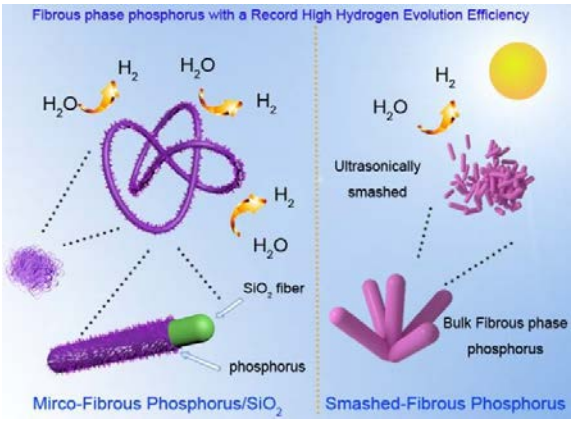
The fast-growing demand for energy and the recognition of man-made global climate change underscore the urgency of developing clean and renewable energy resources to replace fossil fuels. A photocatalyst operates much as chlorophyll does in a plant, absorbing energy from light and causing a chemical reaction. The process of photocatalysis is simply a form of artificial photosynthesis. There are hundreds, if not thousands, of materials that can be used as photocatalysts. But most of them are heavy-metal oxide compounds that are expensive and complicated to produce. Very rare elements are often used to enhance their efficiency. So chemists have been searching for a single element that can perform the same function. Red phosphorous is abundant in the earth's crust and can be extracted fairly easily. At the same time, hydrogen has a high fuel capacity and creates more energy than other chemical fuels. The process of conversion leaves only water as a by-product, not toxic gas.

傳統光催化劑 Traditional Photocatalysts	微纖維紅磷 Micro-fibrous Red Phosphorus
× 大都是重金屬氧化合物 Most are heavy-metal oxide compounds × 昂貴且製造過程複雜 Expensive and complicated production process × 要用上稀有元素來提高效能 Need rare elements to enhance efficiency	✓ 地殼蘊藏量豐富，取之不竭，而且開採容易 Abundant in the earth's crust and can be extracted fairly easily ✓ 氫的能源容量很高，比其他化學燃料產生更大能量 High fuel capacity and creates more energy than other chemical fuels ✓ 生產過程完結後，餘下的副產品只有水，並無有毒氣體 The process of conversion leaves only water as a by-product, not toxic gas

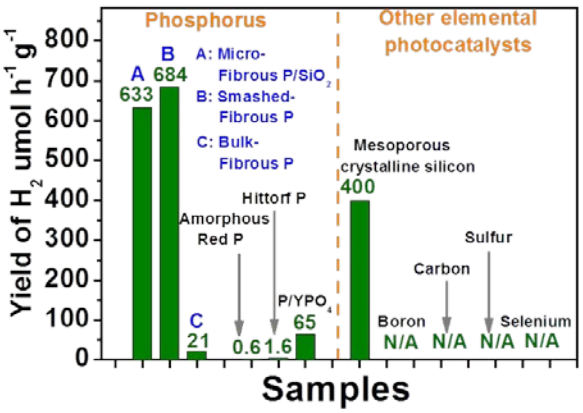


氫氣由玻璃管收集
Hydrogen gas produced is collected by glass tubing system.

團隊設計的實驗設備。
Experiment designed by the team.



以微纖維紅磷從水中製造新潔淨能源 (氫氣) 示意圖。
Diagram showing the production of hydrogen from water via micro-fibrous phosphorus/SiO_2.



微纖維紅磷比其他種類的紅磷、甚至比其他光催化劑，能更有效從水中生產氫氣。
The hydrogen yield by micro-fibrous phosphorus/SiO2 is much higher than that of other red phosphorus, and is the highest among elemental photocatalysts.

可授權專利
Available Patent

Photocatalytic Co-Ps-loaded Red Phosphorus for H2 Formation from Water
(Patent: **US**8,940,656)

Advantages

- Performance for CoP2 : 6 times > Platinum
- Price for CoP2 : 200 times < Platinum

關於余濟美教授 About Prof. Jimmy Yu

余教授是光催化研究領域中的領先專家。2016 年，他獲 *Web of Science* 選為化學及材料科學領域最高被引學者 (最高被引的定義是過去 11 年中，取得引用次數最高的 1%)。余教授發明的光催化淨水及空氣淨化系統技術均已在市場上應用。他擁有多項發明專利，並獲湯森路透 (Thomson Reuters) 譽為「2014 世界最具影響力科學家」之一。

Professor Yu is a leading scientist in the field of photocatalysis. He is selected by *Web of Science* as a most cited researcher in both chemistry and materials science in 2016 (Highly Cited Papers are defined as those that rank in the top 1% by citations for field during the previous 11 years in Web of Science.). Photocatalytic water treatment and air purification systems based on Prof. Yu's inventions have been commercialized. He holds several patents for his inventions, and was named as the "World's Most Influential Scientific Minds" in 2014 by Thomson Reuters.

Story / video featuring the invention in the "Brand Hong Kong" Series by the Hong Kong Government:
http://goo.gl/JS0zUh

土豆網短片介紹
Tudou Video:

更多項目資訊
More information: