PH2OTOGEN

ACCELERATION OF PHOTOCATALYTIC GREEN HYDROGEN PRODUCTION TO MARKET READINESS THROUGH VALUE-ADDED OXIDATION PRODUCTS

Project ID	101137889
PRR 2024	Pillar 1 – Renewable hydrogen production
Call topic	HORIZON-JTI-CLEANH2-2023-01-04: Photoelectrochemical (PEC) and/or photocatalytic (PC) production of hydrogen
Project total costs	EUR 2 498 813.75
Clean H_2 JU max. contribution	EUR 2 498 813.25
Project period	1.1.2024–30.6.2027
Coordinator	Toyota Motor Europe NV, Belgium
Beneficiaries	Commissariat à l'énergie atomique et aux énergies alternatives, École polytechnique fédérale de Lausanne, Friedrich-Alexander-Universität Erlangen-Nürnberg, Helmholtz-Zentrum Berlin für Materialien und Energie GmbH, LGI Sustainable Innovation, Solaronix SA, Stichting Nederlandse Wetenschappelijk Onderzoek Instituten

https://www.ph2otogen.eu/

PROJECT AND GENERAL OBJECTIVES

The Ph2otogen project aims to generate solar hydrogen through a photocatalytic reaction. While most research on photocatalytic hydrogen generation focuses on the splitting of water to form hydrogen and oxygen, Ph2otogen aims to couple hydrogen generation with the oxidation of an organic molecule, such as glycerol oxidation to 1,3-dihydroxyacetone (DHA), in place of oxygen formation. There are several advantages to this approach: (i) it avoids the concomitant production of hydrogen and oxygen, which can result in the formation of an explosive mixture; (ii) since the products are in different states – hydrogen being a gas and DHA an oil – they can be easily separated without the need for specially engineered membranes; and (iii) DHA is around 50 times more valuable than the glycerol starting material and therefore provides another possible revenue stream from the device, which is likely to accelerate the introduction of green hydrogen to the market.

NON-QUANTITATIVE OBJECTIVES

- Development of novel semiconductor materials for hydrogen evolution and glycerol oxidation.
- Building and outdoor testing of a demonstrator capable of concomitant hydrogen evolution and glycerol oxidation.
- Life-cycle and techno-economic analysis of the materials and device to establish a business case.
- Advanced material analysis to elucidate degradation mechanisms and develop countermeasures.
- Engagement with research communities (through publications, conference presentations, social media and webinars) and the general public (through social media and outreach events).

FUTURE STEPS AND PLANS

As a first step, the project is focusing on the synthesis of the hydrogen evolution particles and the oxidising particles and the testing of them at the laboratory scale.

PROJECT TARGETS

Target source	Parameter	Unit	Target	Target achieved?
Project's own objectives	Develop stable and efficient tandem system	Efficiency: % Size: cm^2	Average of > 5 % solar-to-hydrogen efficiency over 500 hours, with oxidation reaction forming a value added product (> 70 % purity) Size: 5–10 cm^2	
	Life-cycle assessment (LCA) and techno-economic analysis (TEA) studies to establish competitive advantage	-	LCA and TEA ready for use by partners	
	Develop stable and efficient oxidising particle	%	Activity for oxidation that matches 5 % solar-to-hydrogen efficiency under sacrificial conditions over 500 hours	
	Demonstration device with power density of 25 kWh/m^2	Power density: kWh/m^2 Performance: % Size: cm^2	Power density: 25 kWh/m^2 Performance: Average of > 5 % solar-to-hydrogen efficiency over 500 hours, with oxidation reaction forming a value added product (> 70 % purity) Size: 500 cm^2	
	Develop stable and efficient hydrogen-evolving particle	%	Average of > 5 % solar-to-hydrogen efficiency under sacrificial conditions over 500 hours	
	Modelling to define flow rates with quantitative agreement with results	-	Qualitative agreement of the model with experimental results	

Clean Hydrogen Partnership
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