SINGLE

ELECTRIFIED SINGLE STAGE AMMONIA CRACKING TO COMPRESSED HYDROGEN

Project ID	101112144
PRR 2025	Pillar 2 – H_2 storage and distribution
Call topic	HORIZON-JTI-CLEANH$_2$-2022-02-04
Project total cost	EUR 2 989 671.25
Clean H_2 JU max. contribution	EUR 2 989 671.25
Project period	01-05-2023 - 30-04-2026
Coordinator Beneficiary	COORSTEK MEMBRANE SCIENCES AS, NO
Beneficiaries	GEA ENERGIA CRIO SL, SINTEF AS, FONDAZIONE ICONS, UNIVERZA V LJUBLJANI, UNIVERSITAT POLITECNICA DE CATALUNYA, AGENCIA ESTATAL CONSEJO SUPERIOR DE INVESTIGACIONES CIENTIFICAS

https://singleh2.eu/

PROJECT AND GENERAL OBJECTIVES

SINGLE aims to demonstrate the competitive advantages of proton ceramic electrochemical reactors for the production of high-purity, pressurised hydrogen (up to 20 bar) from ammonia. This goal will be achieved through the implementation of an innovative proton ceramic electrochemical reactor stack design integrated into a module capable for operation at a scale of 10 kg hydrogen per day. To reach this capacity the module will comprise of twenty individual stacks.

NON-QUANTITATIVE OBJECTIVES

- Optimise the proton ceramic electrochemical reactor catalytic activity for ammonia dehydrogenation.
- Optimise and qualify proton ceramic electrochemical reactor stacks and system components.
- Fabricate proton ceramic electrochemical reactor stacks including design, assembly, construction and testing of the 10 kg H_2/day module.
- Assess the life cycle, value chain economics and critical raw materials.
- Carry on dissemination, communication and standardisation activities.

PROGRESS, MAIN ACHIEVEMENTS AND RESULTS

- Ni/BCZY support catalytic activity and stability had been optimised by infiltration of active metal.
- Candidate alloy materials have been identified for constructing and safe operating reactor housing under ammonia conditions.
- Cells, KETs and stacks have been manufactured.

FUTURE STEPS AND PLANS

- Stacks for 10kg H_2/day module will be fabricated.
- Design, assembly, construction, and testing of the 10 kg H_2/day module.
- The life cycle, value chain economics and critical raw materials will be assessed.

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PROJECT TARGETS

Target source	Parameter	Unit	Target	Achieved to date by the project	Target achieved?	SoA result achieved to date (by others)	Year for reported SoA result
Project's own objectives	Ammonia conversion (CATALYST)	%	> 98 at 600 °C	99.2	✓	98 % at 650 °C	2022
	Durability (CATALYST)	%	< 1 %/kh decrease in conversion at 600 °C	-		N/D for >1kh	2022
	Current density (CELL)	A/cm2	> 1	-		0.8	2022
	ASR (Current collector/electrode/ electrolyte) (CELL)	Ωcm2	< 0.5	-		1.2	2022
	NH_3 conversion (CELL)	%	> 99.9	-		> 99.98	2022
	Faradaic efficiency (CELL)	%	> 98	-		98	2022
	Hydrogen recovery (CELL)	%	> 99	-		99	2022
	Durability (CELL)	%/kh voltage degradation on cell level at 0.75 Acm	0.8	-		0.8	2022
	Total current (STACK)	A	>85	44		67	2022
	NH_3 conversion (STACK)	%	>99.8	98.4 (at 750°C)		N/A	N/A
	Faradaic efficiency (STACK)	%	95	96 (at 10 bar, 700°C)		>98	2022
	Hydrogen Recovery (STACK)	%	>98	86 (at 650°C)		98	2022
	Pressure Tolerance	Bar	30	15		31	2022
	Hydrogen Purity	%	>99.99	-		>99.995	2022
	Efficiency HHV	%	>90	-			
	NH_3 Conversion (10kg/day MODULE)	%	>90	-			
	NH_3 Conversion (10kg/day MODULE)	%	>99.5	-		N/A	N/A
	Hydrogen Recovery (10kg/day MODULE)	%	>95	-			
	Number of hours operated at 10 kg/day	h	>500	-			
	Pressure tolerance	bar	25	-			

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