



TECNOLOGÍAS ELECTROQUÍMICAS Y FOTOELECTROQUÍMICAS INNOVADORAS PARA LA PRODUCCIÓN Y USO DE HIDRÓGENO VERDE

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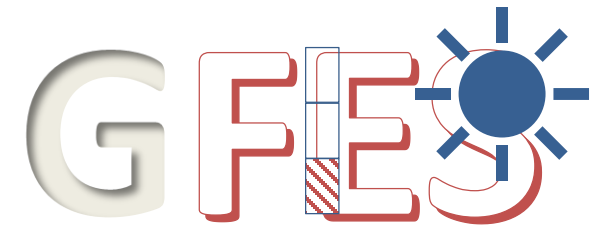
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Universitat d'Alacant
Universidad de Alicante



Fotoquímica y Electroquímica
de Semiconductores



- SISTEMA DE FOTOELECTROLISIS DEL AGUA (PROYECTO FOTOH₂)
- SISTEMA DE FOTORREFORMADO ELECTROQUÍMICO DEL AGUA
- ELECTROLIZADORES REVERSIBLES
- CAPACIDADES



FOTOCH₂

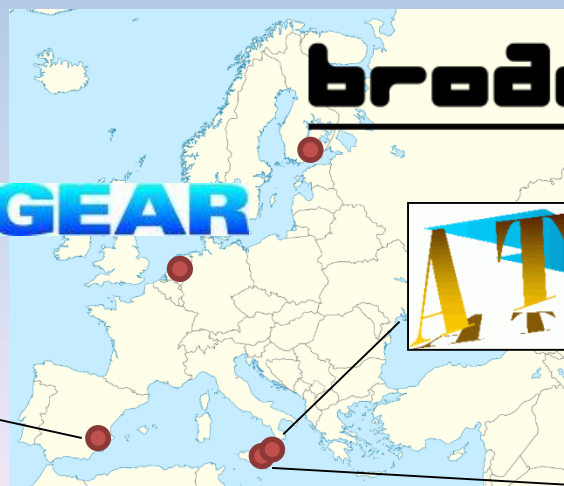


This project has received funding from the European Union's Horizon2020 Framework Programme under grant agreement no 760930



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HYGEAR



broddbit



Consiglio Nazionale
delle Ricerche



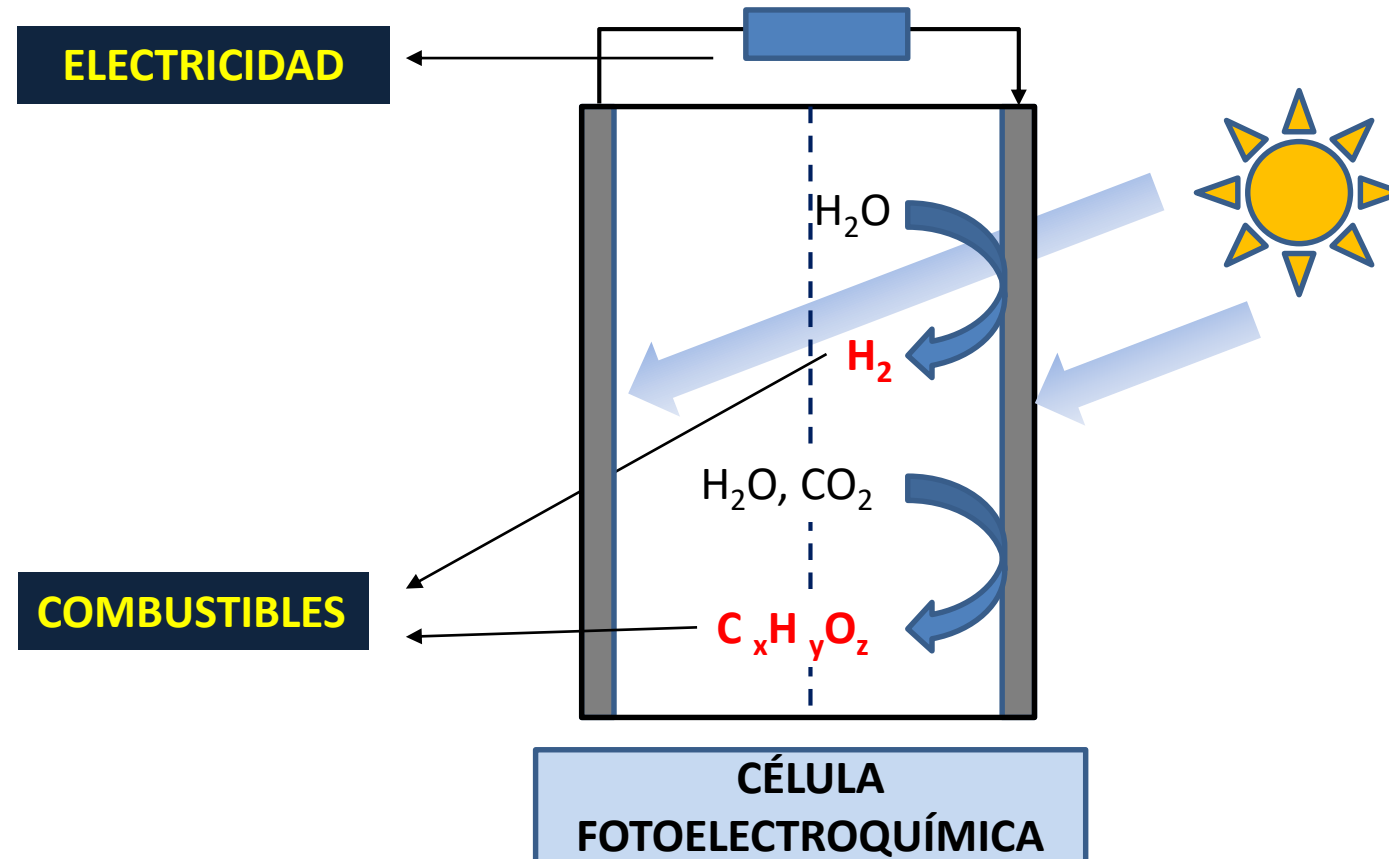
FINALIDAD DEL PROYECTO

Avanzar en la síntesis y caracterización fotoelectroquímica de óxidos metálicos para su aplicación en la conversión y acumulación de energía (fotosíntesis artificial)

Contribuir al diseño de un prototipo viable comercialmente y escalable para la fotoelectrolisis del agua

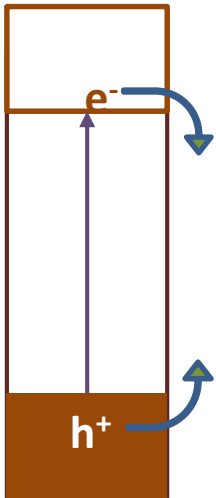
CONTEXTUALIZACIÓN DEL PROYECTO

CONVERSIÓN FOTOELECTROQUÍMICA DE ENERGÍA

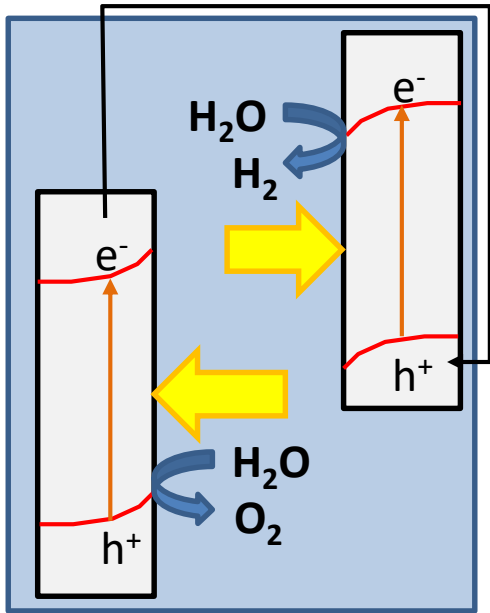
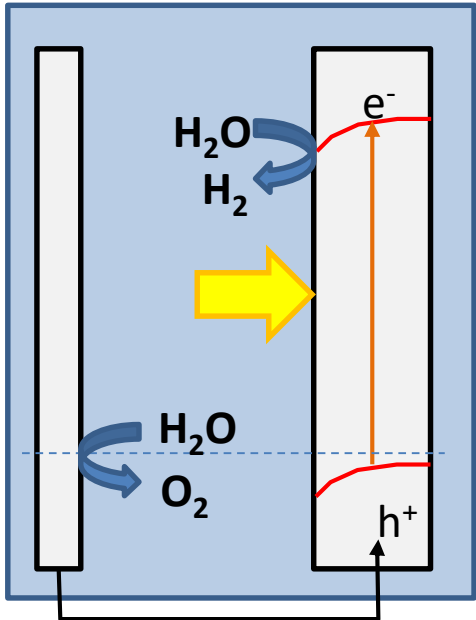
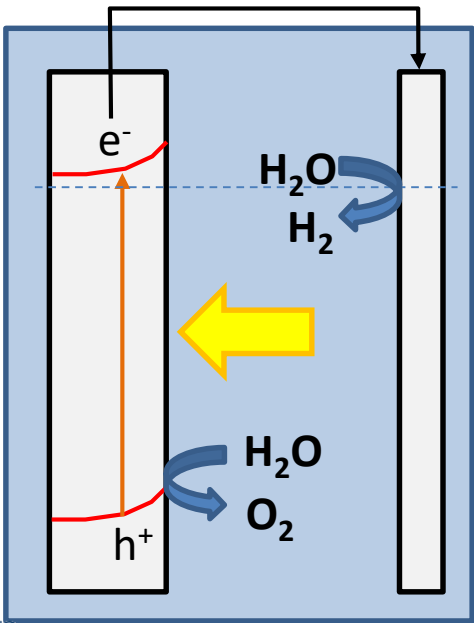
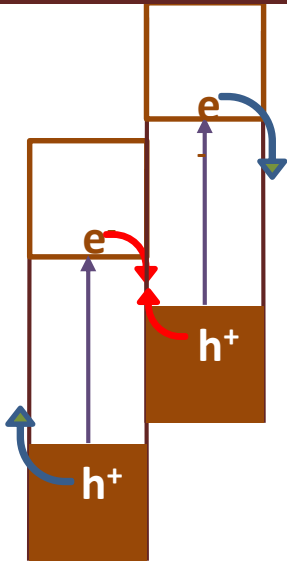


SISTEMA EN UNA ETAPA FRENTE A SISTEMA EN DOS ETAPAS (ELECTROQUÍMICA)

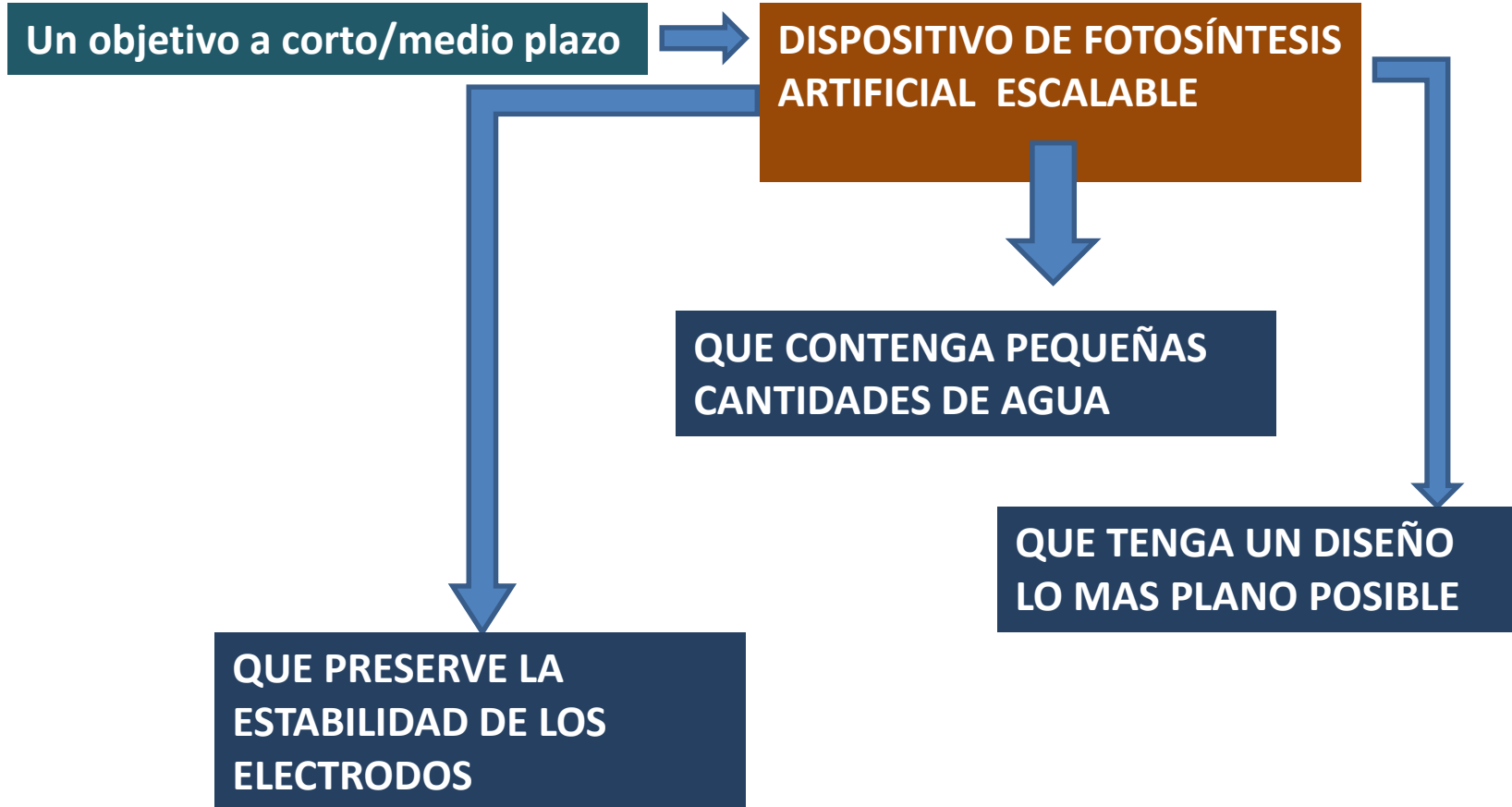
UNA ETAPA

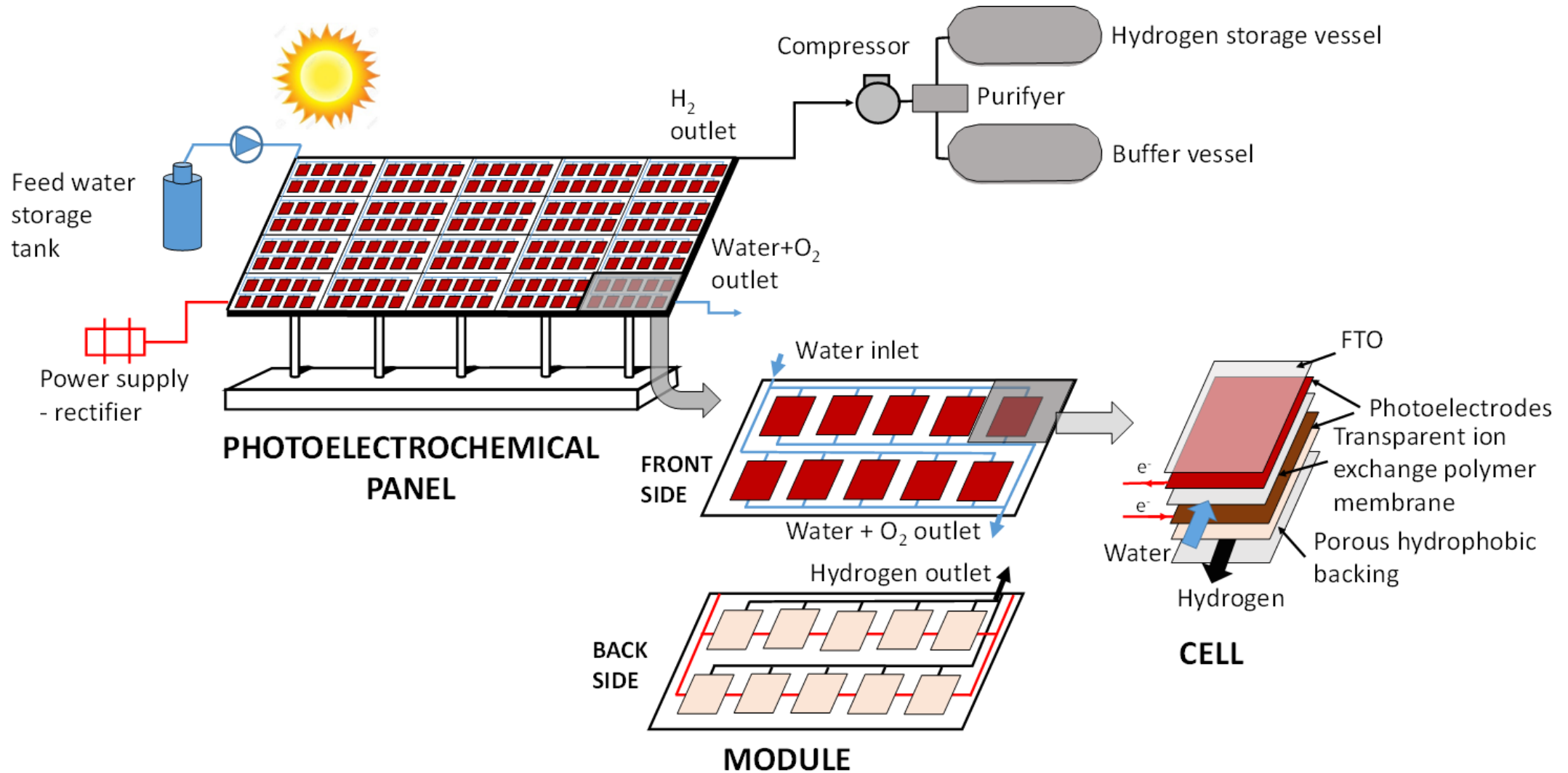


DOS ETAPAS



LOS OBJETIVOS DEL PROYECTO



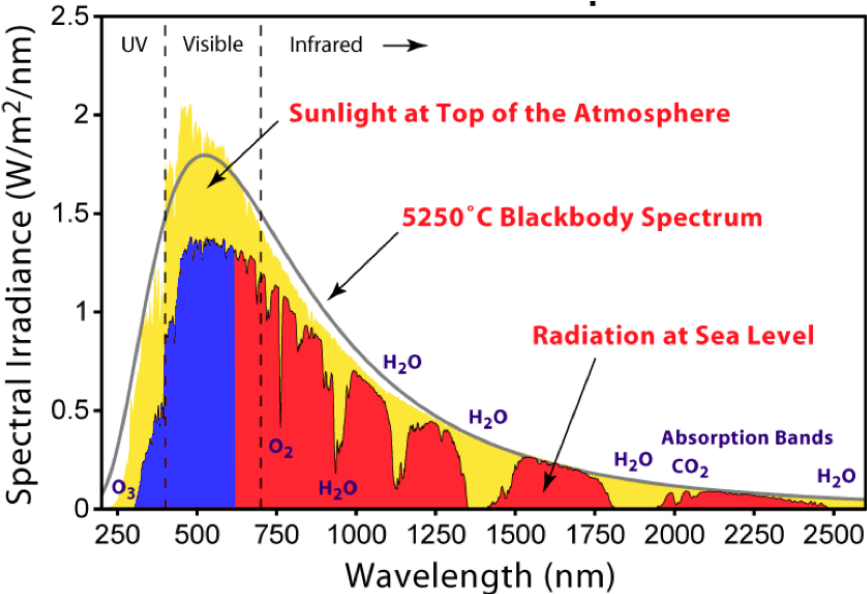


LOS ÓXIDOS BINARIOS

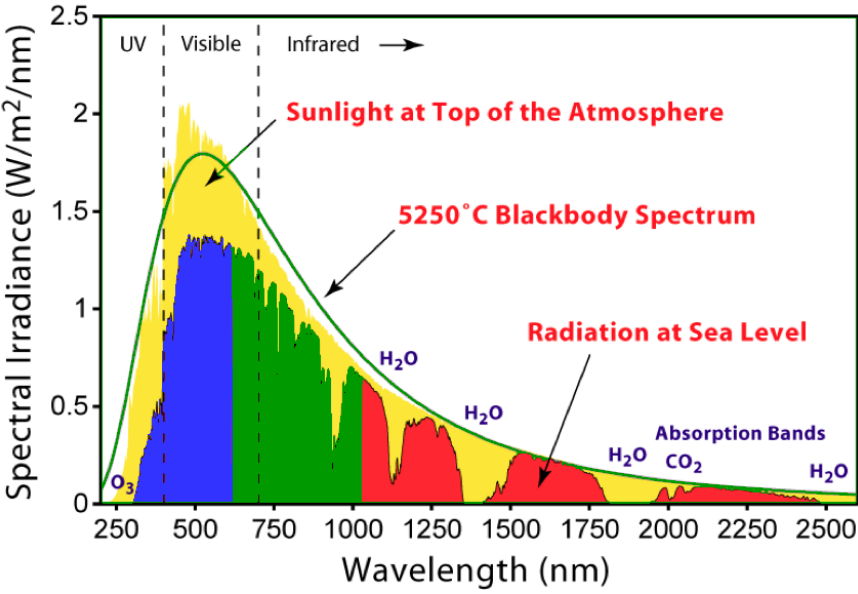
¿Existe alguna combinación prometedora?



P. ej. CuO y Fe₂O₃



Fe₂O₃



CuO

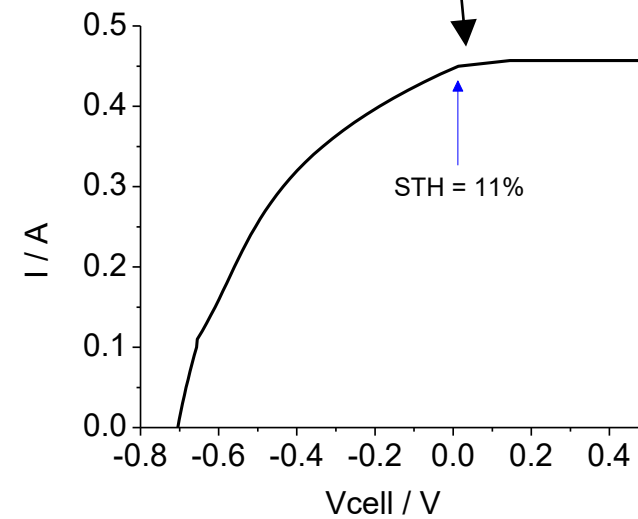
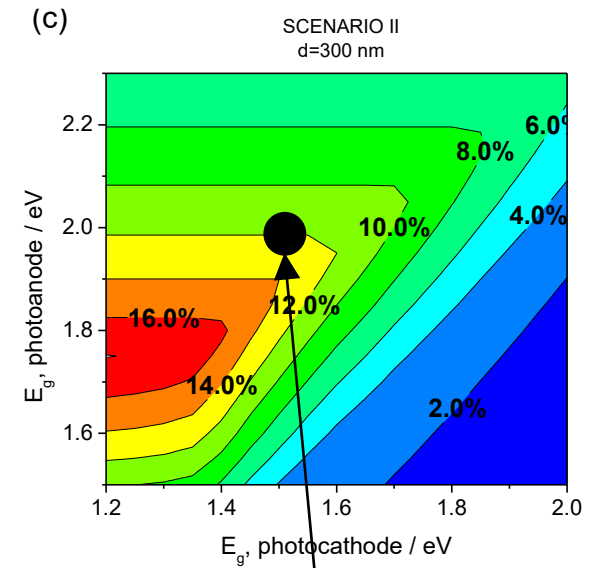
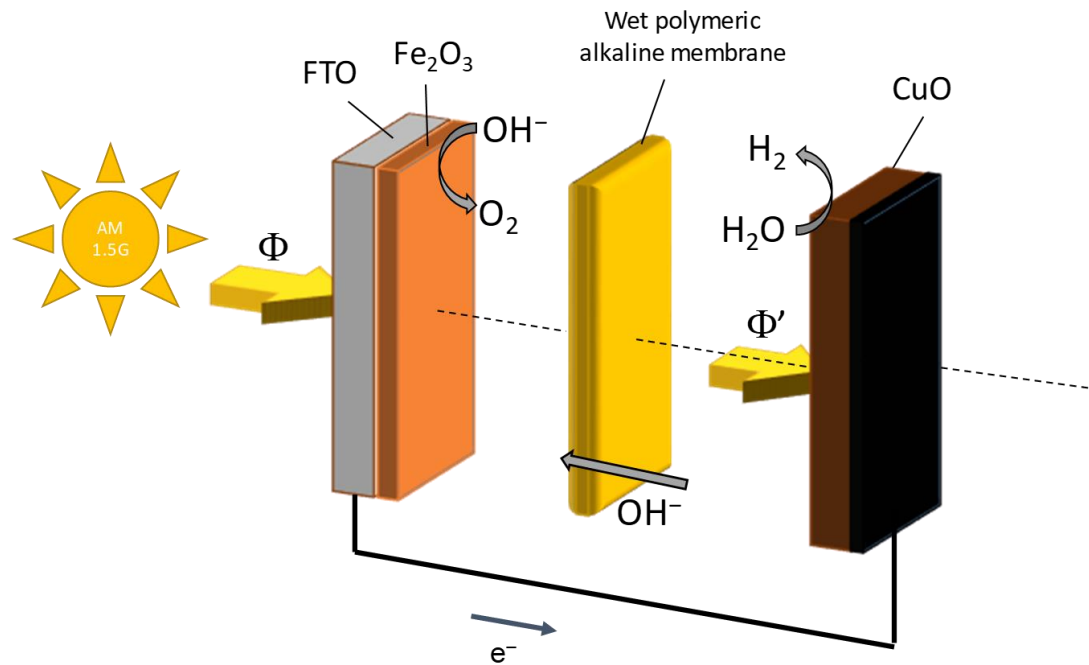
Las absorciones de luz son complementarias



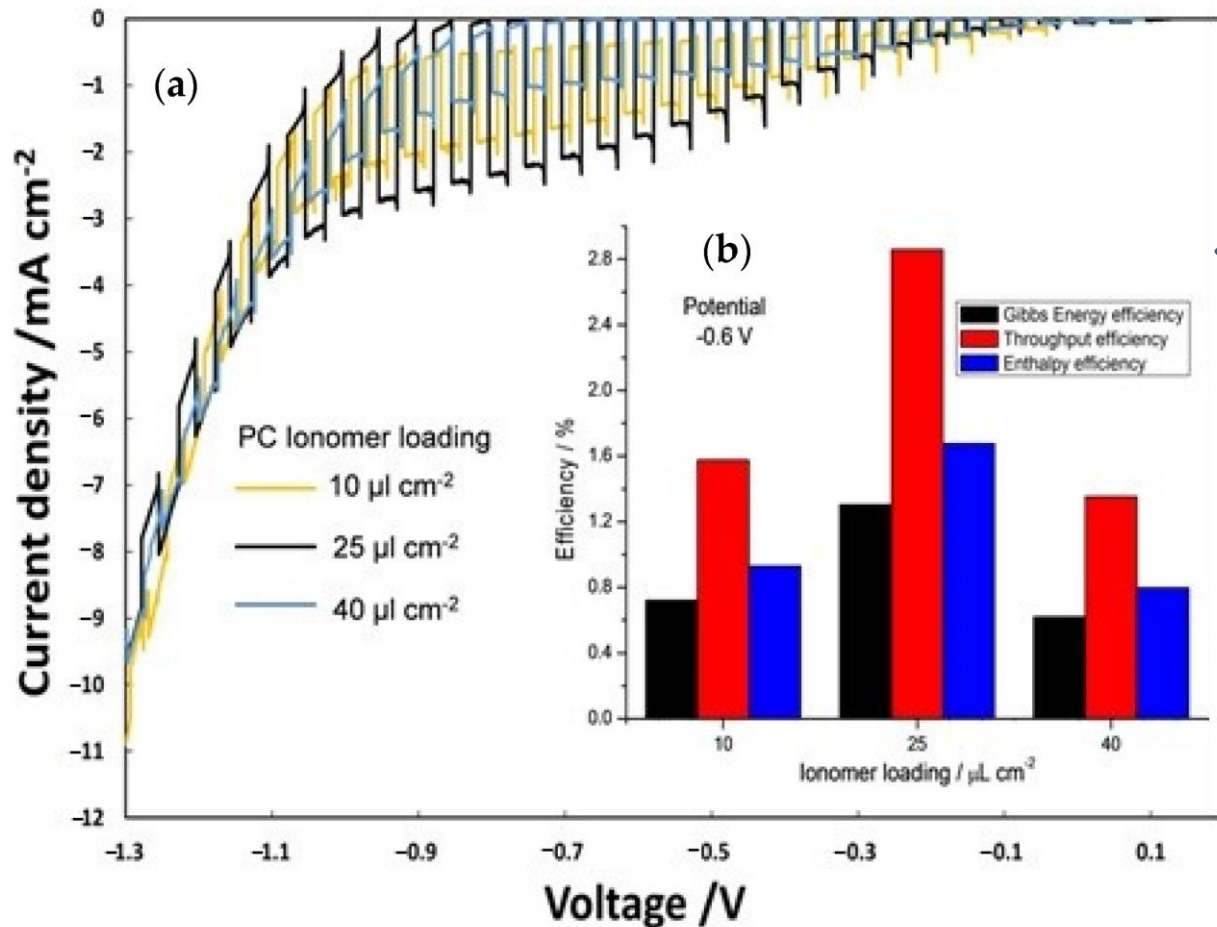
PEC CELL

TANDEM CELL: HEMATITE-CuO

PHOTOANODE		PHOTOCATHODE		MEMBRANE	
$E_{fb} / \text{V vs RHE}$	0.3	$E_{fb} / \text{V vs RHE}$	1	$\sigma / \text{S cm}^{-1}$	0.1
ϵ_{hem}	80	ϵ_{CuO}	115	$L / \mu\text{m}$	50
L_p / nm	5	L_n / nm	50	A / cm^2	50
A / cm^2	50	A / cm^2	50		
N_D / cm^{-3}	10^{17}	N_A / cm^{-3}	10^{17}	$R (\Omega)$	0.001
d / mm	0.150	d / mm	2		



MEMBRANE ELECTRODE ASSEMBLY



- Fumasep membrane (FAA3-50 from Fumatech)
- Thickness of 50 μm
- Based on a brominated polysulfone backbone with quaternary ammonium side chain groups

EFFECT OF THE IONOMER DISPERSION LOADING

$$\text{Enthalpy efficiency } \eta_{\text{Enth}} = I_p (\Delta H/nF - E_{\text{bias}})/P_{\text{in}} = I_p (E_{\text{tn}} - E_{\text{bias}})/P_{\text{in}}$$

$$\text{Gibbs Energy efficiency } \eta = I_p (\Delta G/nF - E_{\text{bias}})/P_{\text{in}} = I_p (E_{\text{rev}} - E_{\text{bias}})/P_{\text{in}}$$

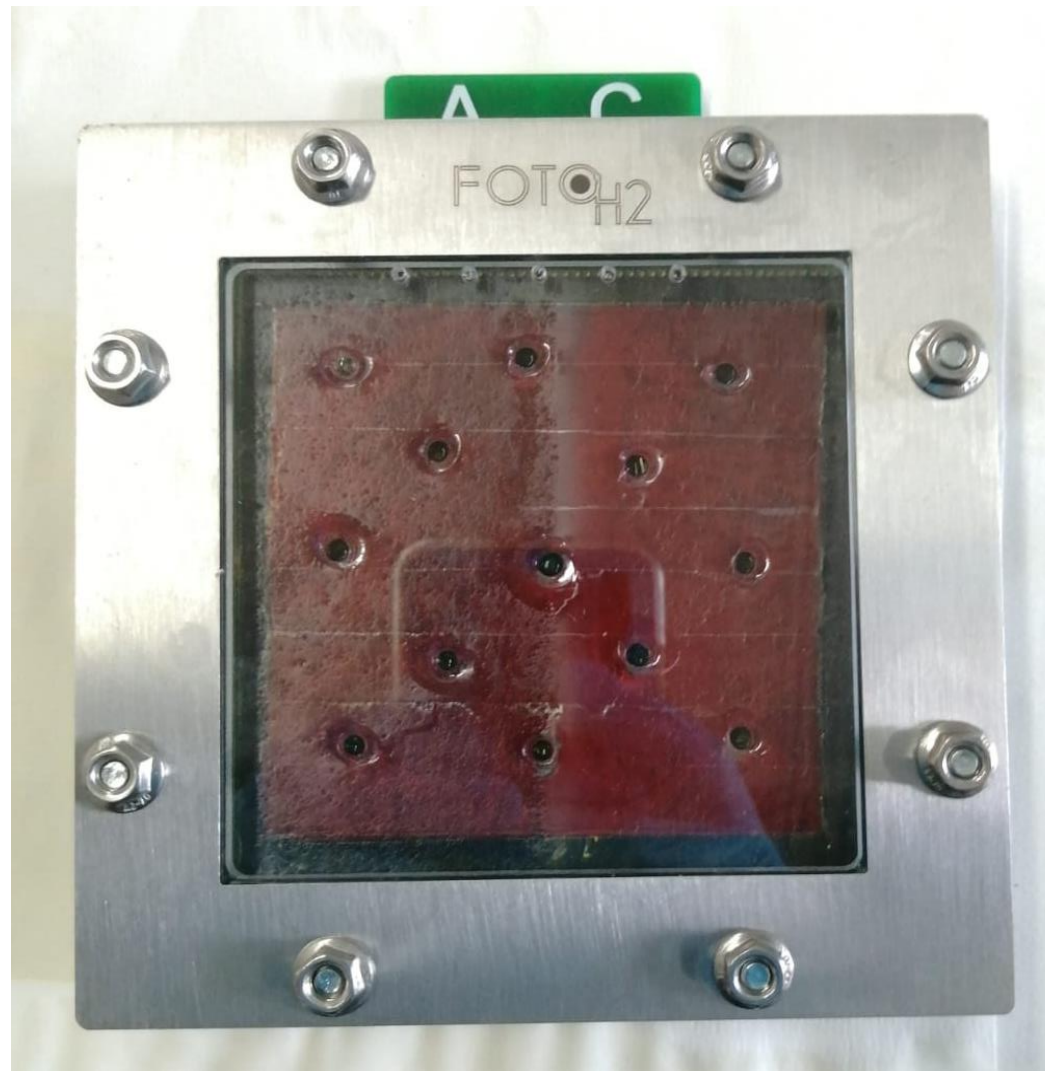
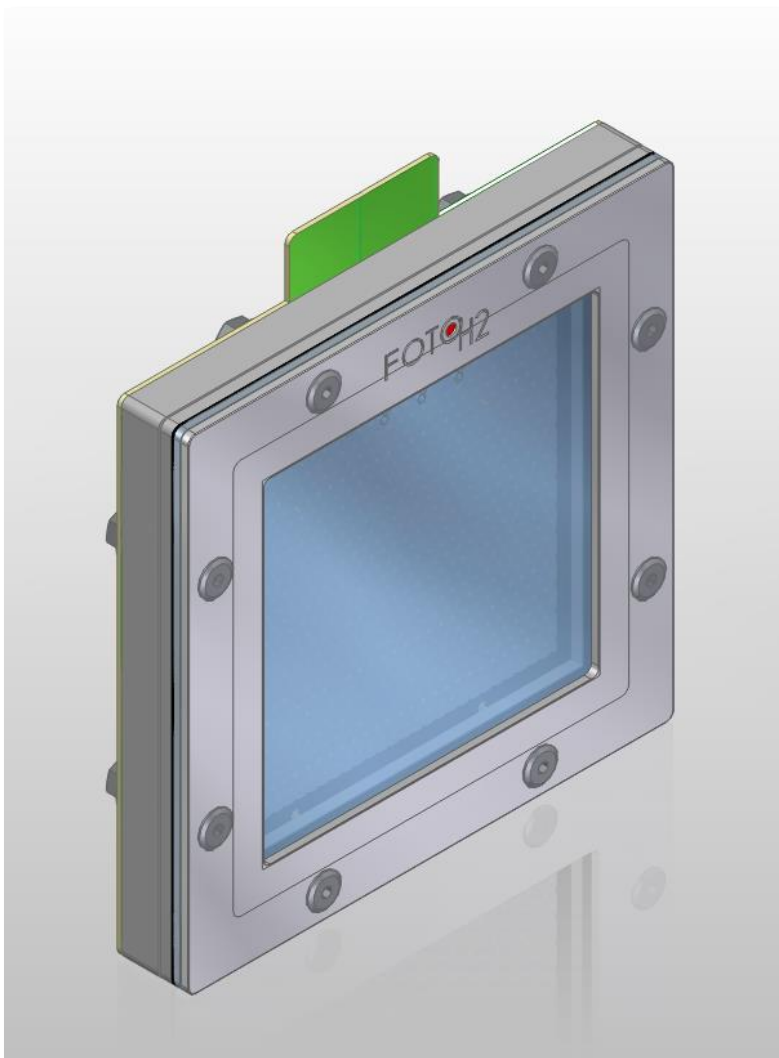
$$\text{Throughput efficiency } \eta_{\text{throughput}} = I_p (\Delta H/nF) / (P_{\text{in}} + I_p E_{\text{bias}}) = I_p E_{\text{tn}} / (P_{\text{in}} + I_p E_{\text{bias}})$$

$E_{\text{tn}} = 1.48 \text{ V}$, $E_{\text{rev}} = 1.23 \text{ V}$, $E_{\text{bias}} \equiv V$, $P_{\text{in}} \equiv \text{mW cm}^{-2}$ and $I_p = I_{\text{light}} - I_{\text{dark}} \equiv \text{mA cm}^{-2}$.

Polymers **2020**, *12*(12), 2991



SCALING-UP THE PEC CELL





PEC PANEL



ELECTROLIZADORES REVERSIBLES

Material es electródicos avanzados
para fotoelectrolizadores y
electrolizadores reversibles de
membrana de intercambio aniónico
(AEM4H2)



RENEWABLE ENERGY SOURCES



END USE: ELECTRICITY



DIRECT ENERGY
CONVERSION

PHOTOELECTROLYZER



H₂

O₂

REVERSIBLE
ELECTROLYZER

H₂O

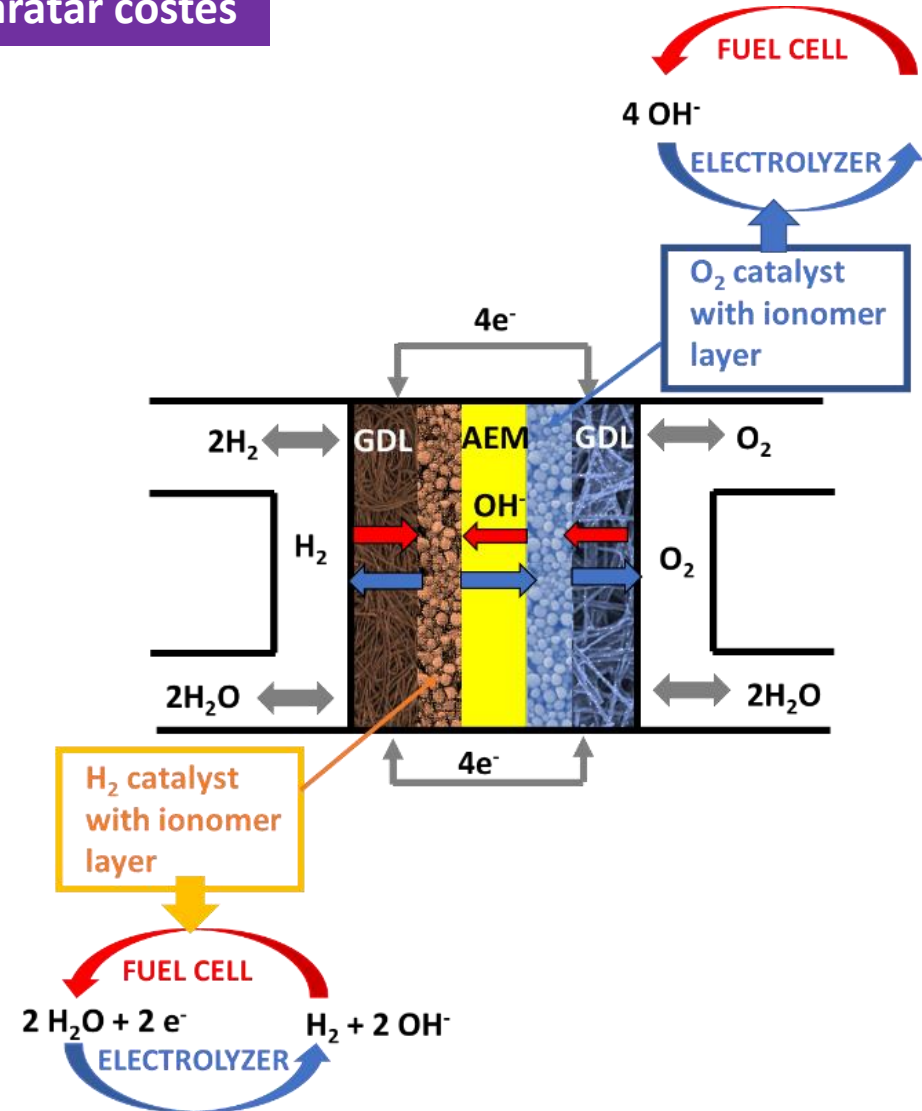
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ELECTROLIZADORES REVERSIBLES

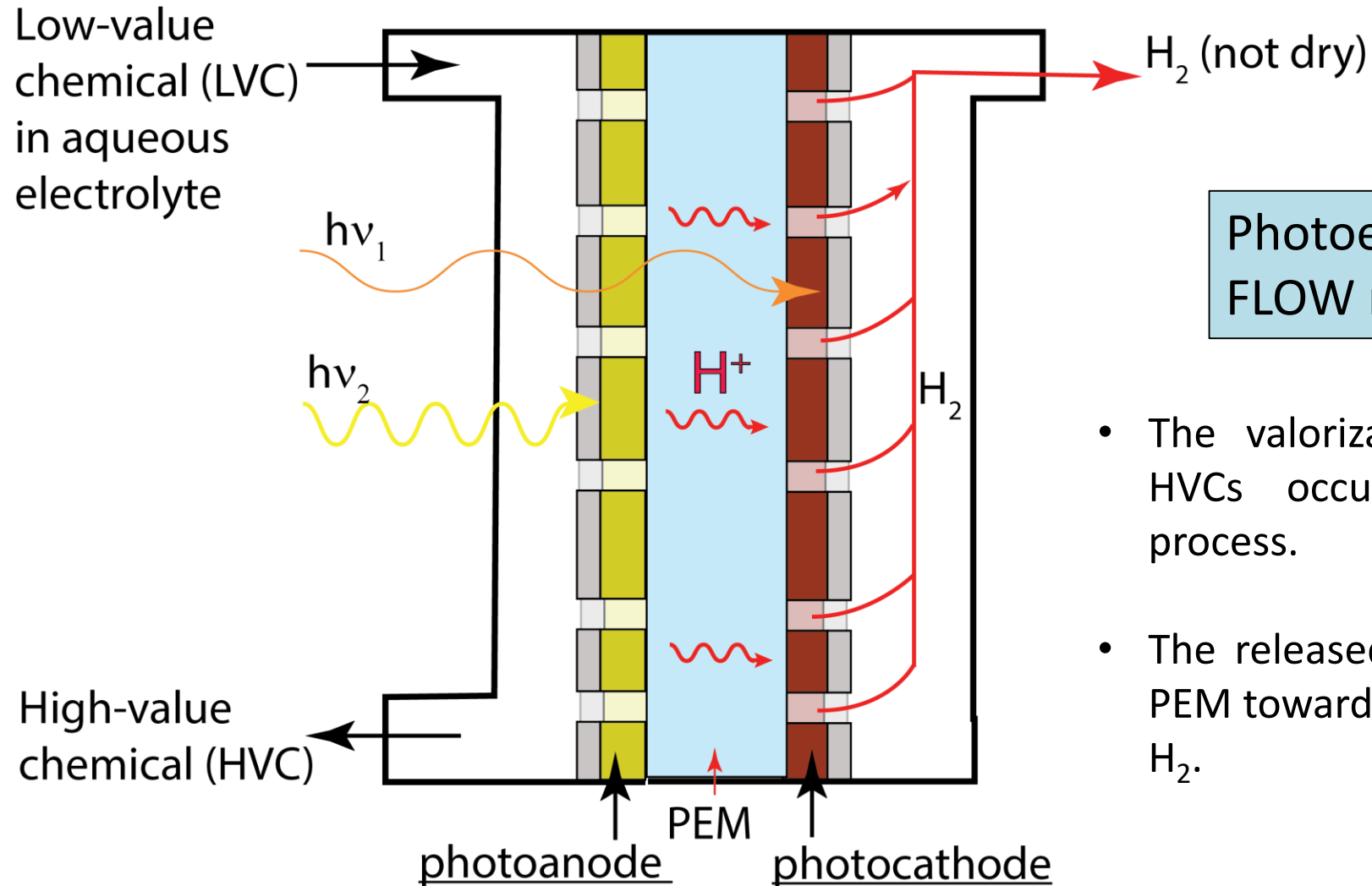
ELECTROLIZADORES DE MEMBRANA POLIMÉRICA ALCALINA (AEM ELECTROLYZER)

TRL bajo. Adecuada para I+D. Potencial para abaratar costes

- INVESTIGACIÓN SOBRE AGLOMERANTES/IONÓMEROS
- DESARROLLO DE ELECTROCATALIZADORES (OER/ORR y HER/ORR) (PGM-free)
- CARACTERIZACIÓN DE DISPOSITIVOS



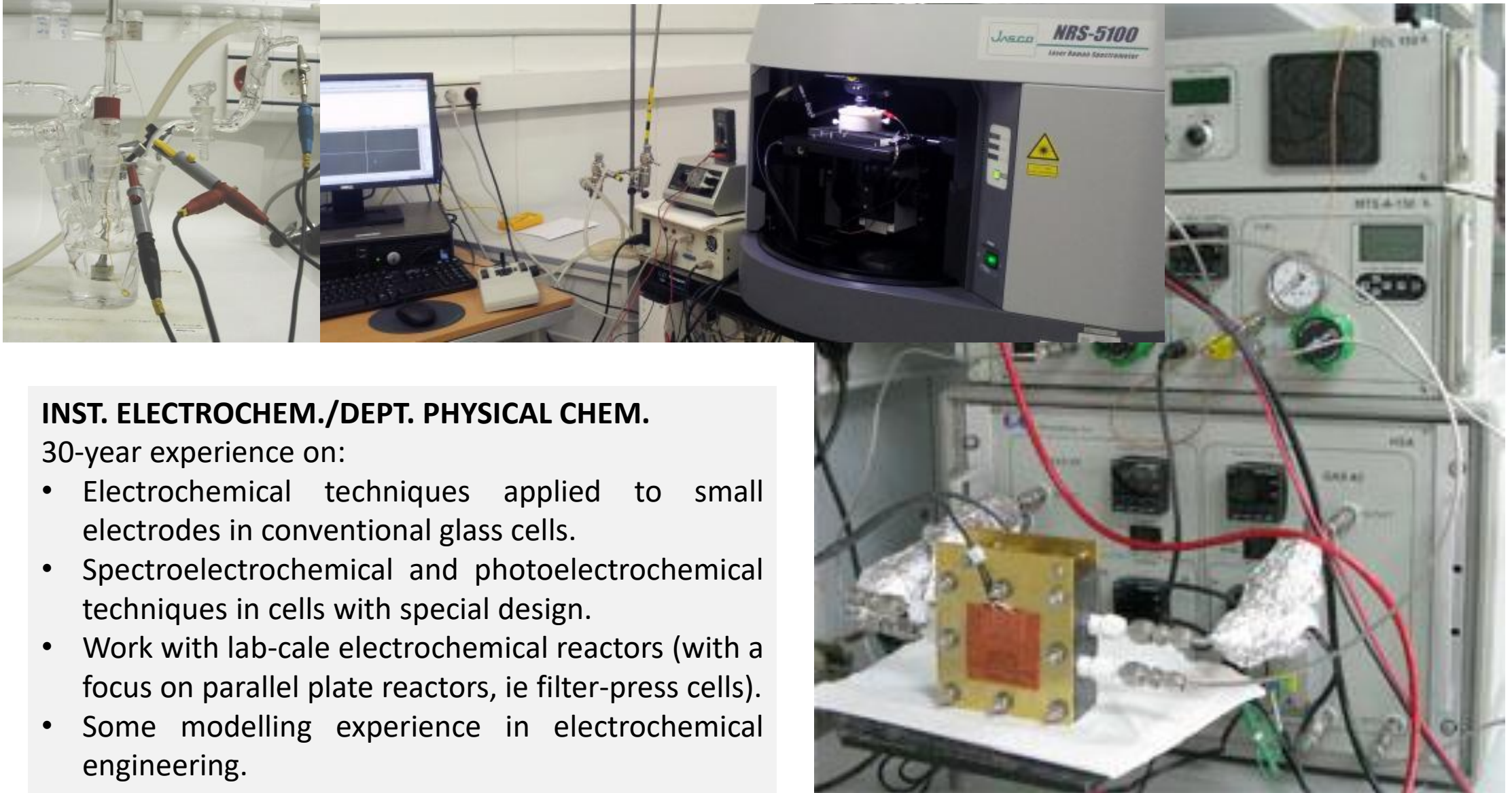
SISTEMA DE FOTORREFORMADO ELECTROQUÍMICO DEL AGUA



Photoelectrochemical FLOW reactor

- The valorization reaction of LVCs into HVCs occurs via a dehydrogenation process.
- The released H^+ are shuttled across the PEM towards to photocathode to produce H_2 .

CAPACIDADES

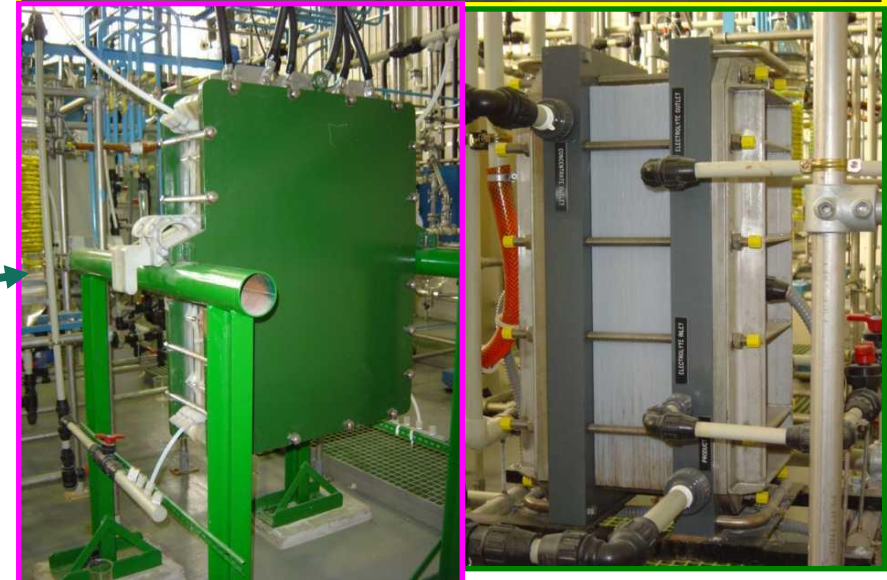
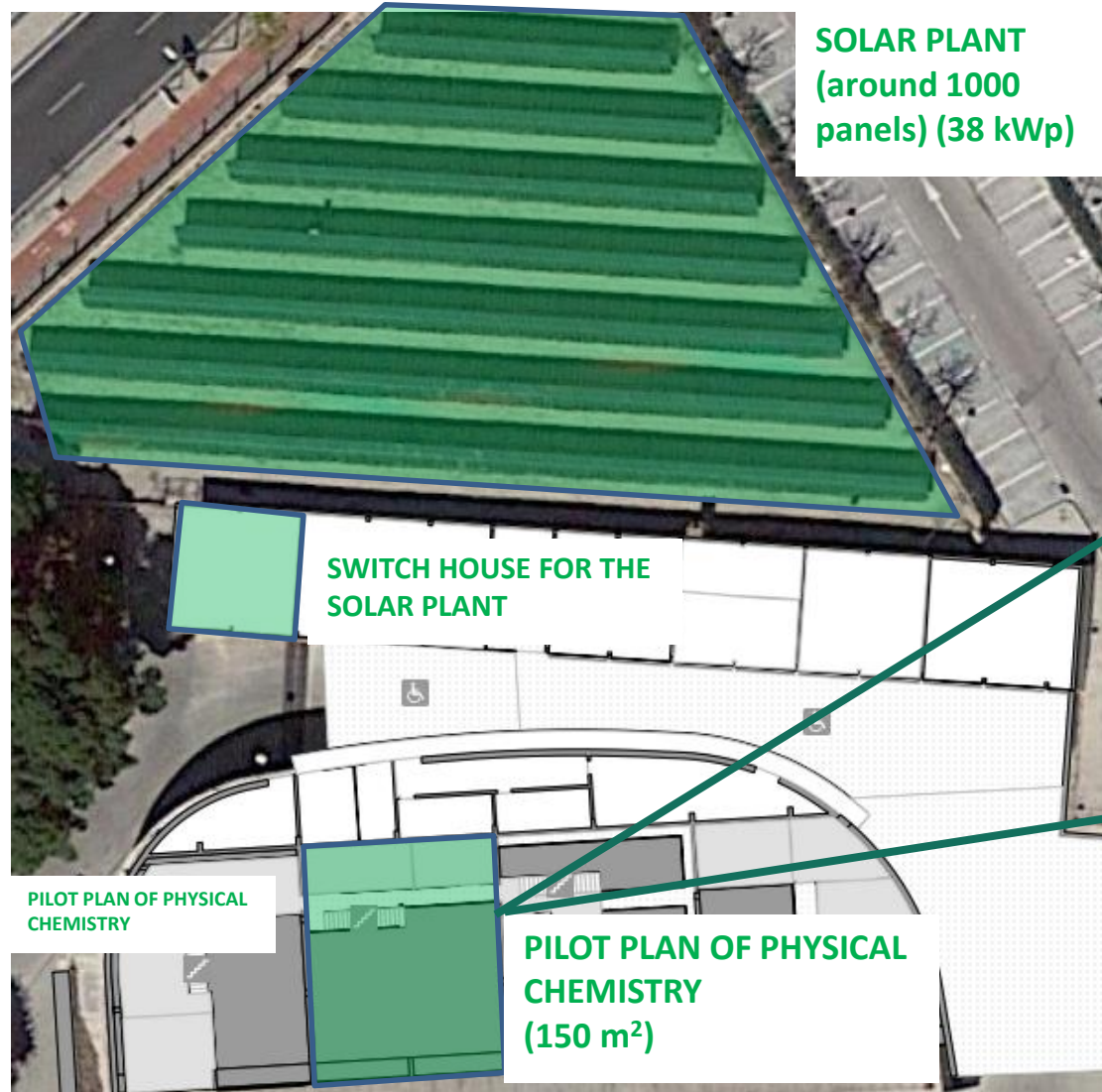


INST. ELECTROCHEM./DEPT. PHYSICAL CHEM.

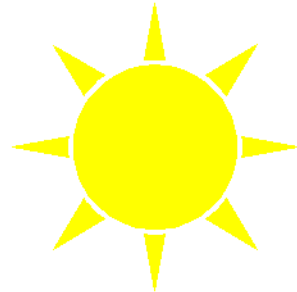
30-year experience on:

- Electrochemical techniques applied to small electrodes in conventional glass cells.
- Spectroelectrochemical and photoelectrochemical techniques in cells with special design.
- Work with lab-scale electrochemical reactors (with a focus on parallel plate reactors, ie filter-press cells).
- Some modelling experience in electrochemical engineering.

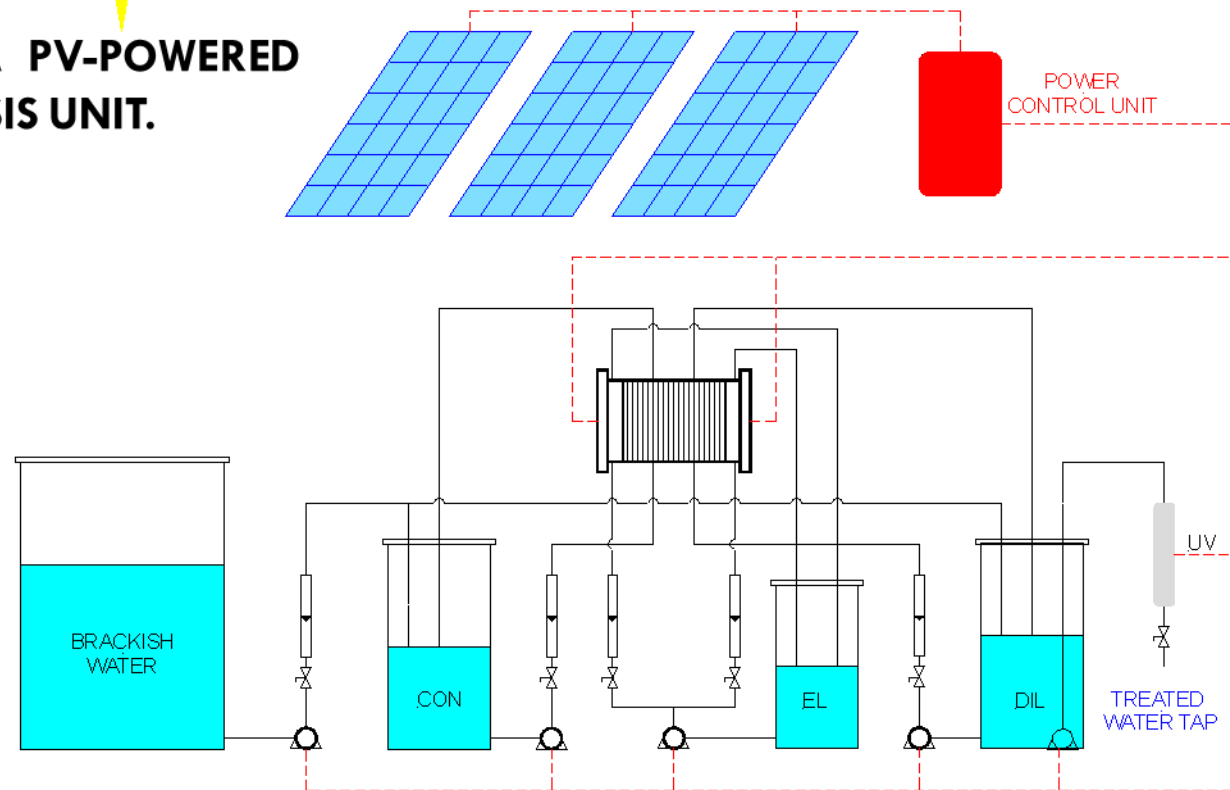
CAPACIDADES

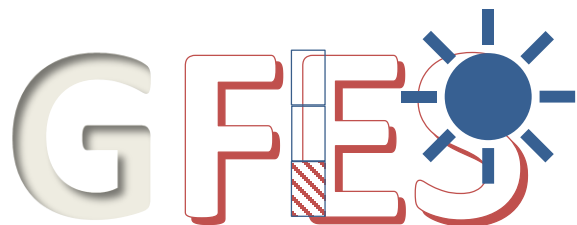


CAPACIDADES



**SKETCH FOR A PV-POWERED
ELECTRODIALYSIS UNIT.**





Fotoquímica y Electroquímica de Semiconductores

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This project has received funding from the European Union's Horizon2020 Framework Programme under grant agreement no 760930



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