Chemistry Institute of Araraquara – UNESP - BRAZIL

Sustainable Energy Production

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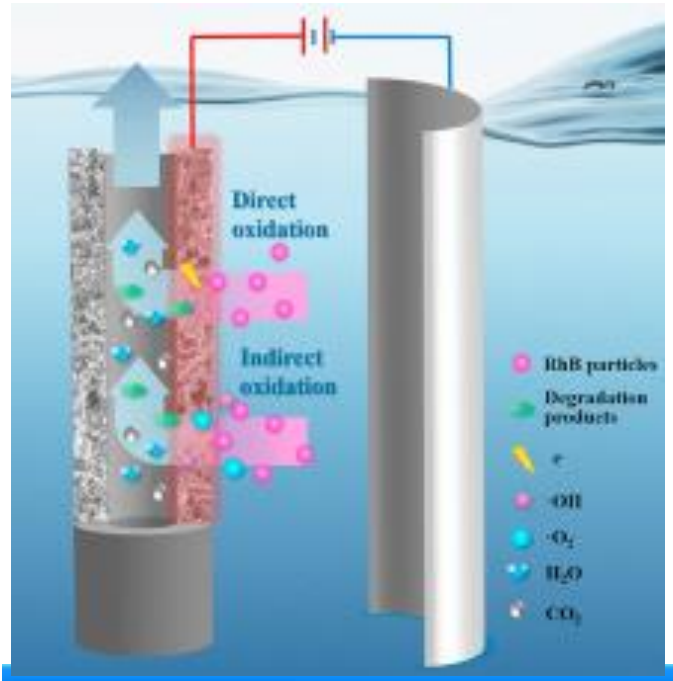
Profª. Drª. Pilar T. Sotomayor

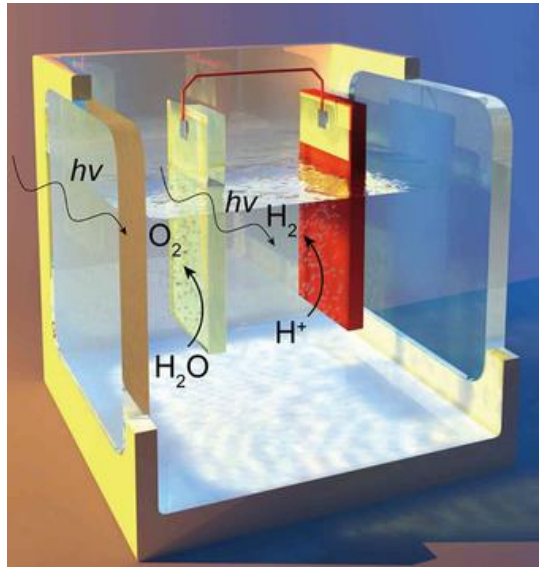
Profª. Drª. Juliana F. de Brito

RESEARCH

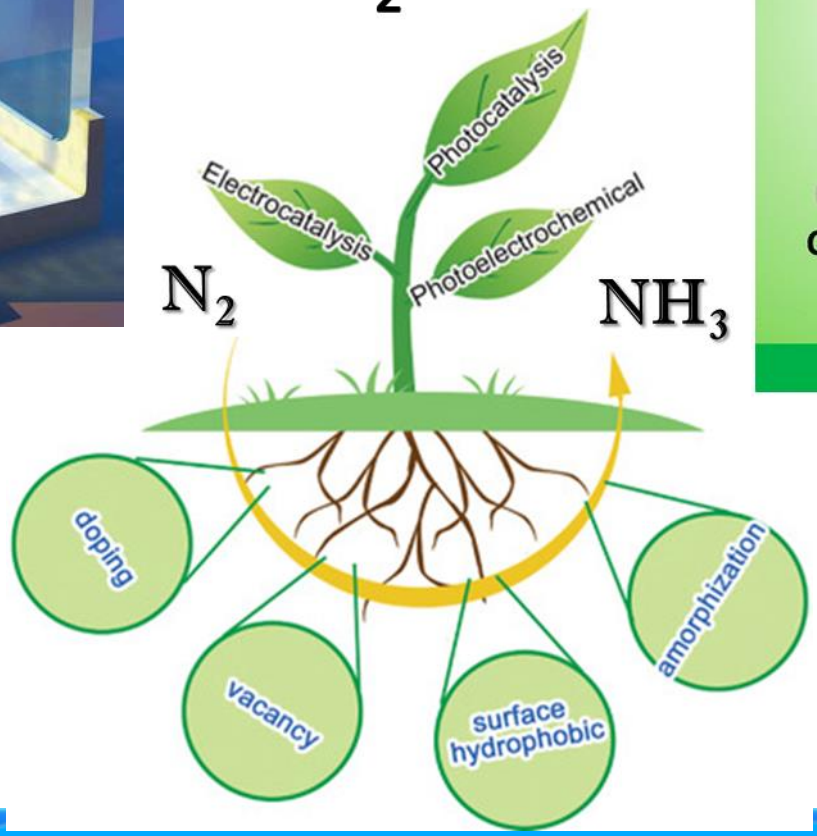
Water treatment



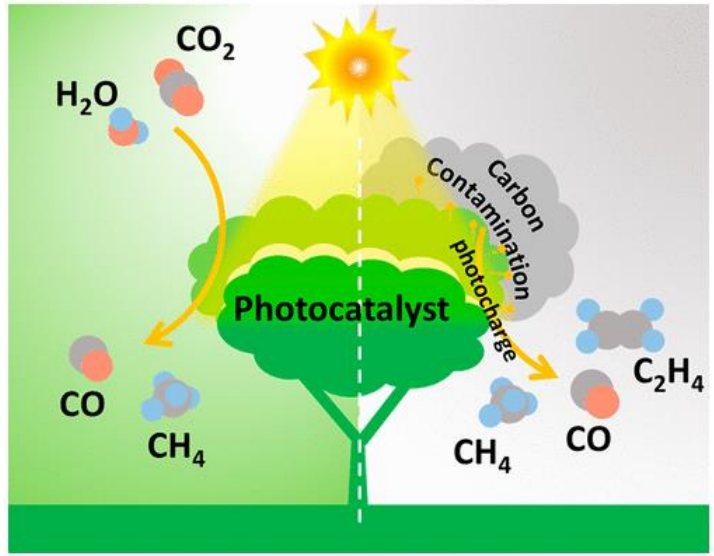
H_2 generation



N_2RR

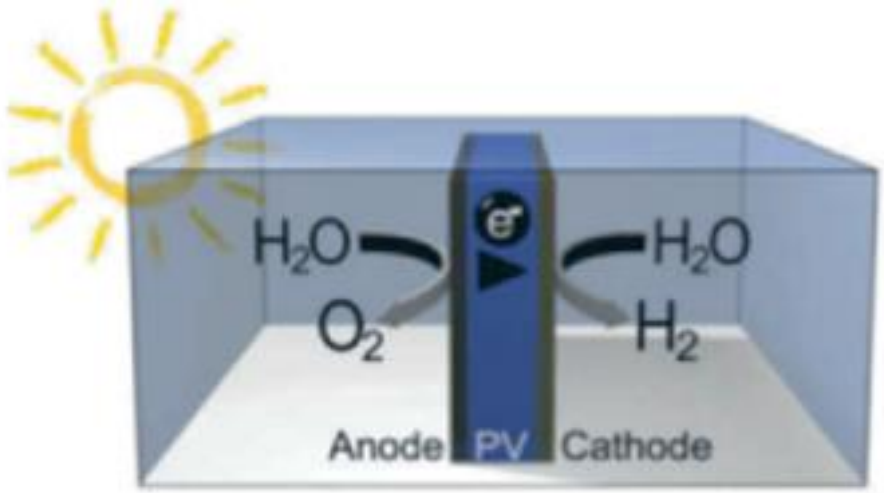


CO_2RR

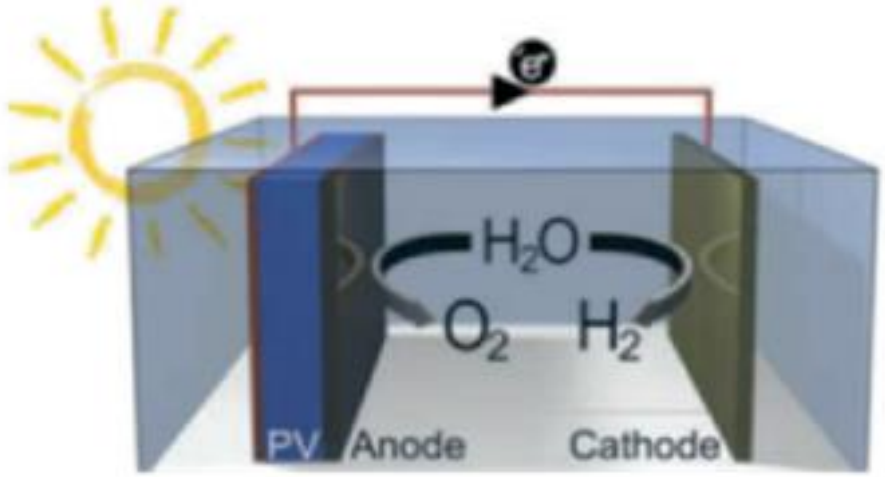


METHOD

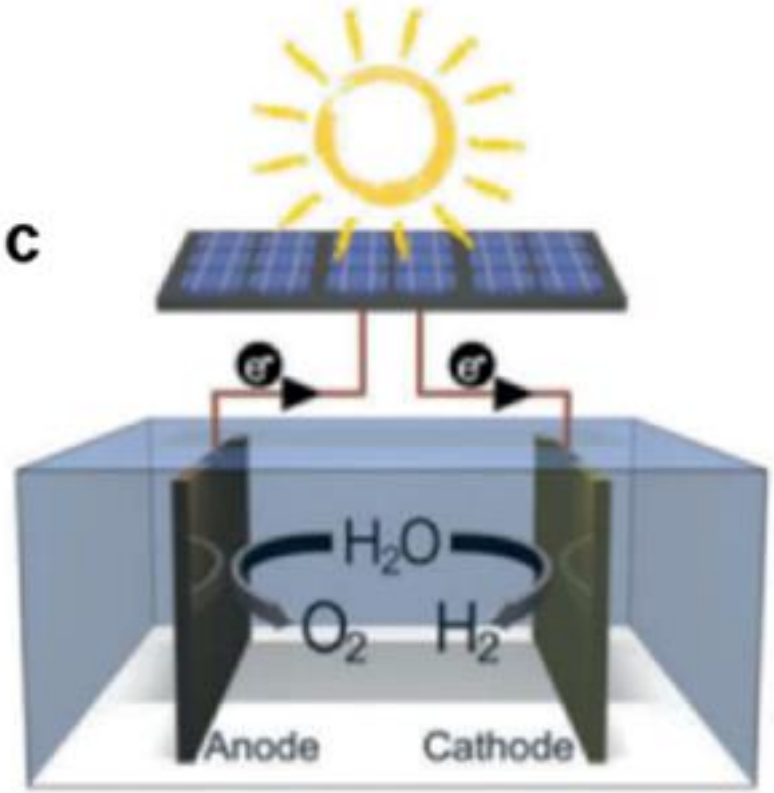
a


H_2O
O_2
H_2O
H_2
Anode
PV
Cathode

b


H_2O
O_2
H_2
PV
Anode
Cathode

c


H_2O
O_2
H_2
Anode
Cathode

Contents list

Electr

journal homepage: www.j

Ammonia production from nitrogen un
overpotential, and mild conditions

Juliana Ferreira de Brito [a], Magno Barcelos Costa
Lucia Helena Mascaro [a,*]

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[b] Department of Chemistry and Biochemistry, The University of Texas at Arlington, Arlington, Texas 76019-0065 USA

Journal of The Electrochemical Society, **166** (5) H3231-H3238 (2019) H3231

JES Focus Issue on Semiconductor Electrochemistry and Photoelectrochemistry in Honor of Krishnan Rajeshwar

Combination of Photoelectrocatalysis and Ozonation as a Good Strategy for Organics Oxidation and Decreased Toxicity in Oil-Produced Water

Juliana Ferreira de Brito, [1,z] Guilherme Garcia Bessegato, [1] Pedro Rafael Fraga de Toledo e Souza, [1] Taís Suelen Viana, [2] Danielle Palma de Oliveira, [2] Carlos Alberto Martínez-Huitle, [3] and Maria Valnice Boldrin Zanoni [1,z]

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[2] Universidade de São Paulo (USP), Escola de Ciências Farmacêuticas de Ribeirão Preto, 14040-903 Ribeirão Preto, SP, Brazil

Contents lists av

Applied Catalys

journal homepage: ww

Role of CuO in the modification of the pl
behavior of TiO_2 nanotube thin films

Juliana Ferreira de Brito [a,b], Francesco Tavella [a], Chia
Maria Valnice Boldrin Zanoni [b], Gabriele Centi [a], Sigl

[a] University of Messina, ERIC aisbl and CASPE/INSTM, Departments ChiBioFarAm and MIFT, viale F. Stagno d'Alcontres 31, 98166 Messina, Italy
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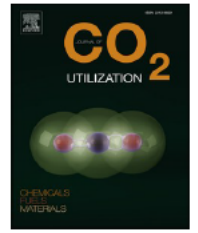
Journal of CO2 Utilization

journal homepage: www.elsevier.com/locate/jcou



All-solution processed $CuGaS_2$-based photoelectrodes for CO_2 reduction

Juliana Ferreira de Brito [a,1], Marcos Antonio Santana Andrade Jr [a,1], Maria Valnice Boldrin Zanoni [b], Lucia Helena Mascaro [a,*]

[a] Department of Chemistry, Federal University of São Carlos, Rod. Washington Luiz, Km 235, CEP, 13565–905 São Carlos, SP, Brazil
[b] Univ. Estadual Paulista, Institute of Chemistry, UNESP, Rua Francisco Degni, 55, Bairro Quitandinha, 14800–900 Araraquara, SP, Brazil

Sustainable Energy from Electrochemical Reactions

CAPTURING ENERGY FROM AIR: THE CO2 TO FUEL CONVERTER

Taking inspiration from how plants and microbes convert CO2 into energy may lead to a sustainable fuel of the future that can satisfy our growing energy demands.

SHARE

https://www.merckgroup.com/en/research/science-space/envisioning-tomorrow/scarcity-of-resources/co2-conversion.html

Sustainable Energy from Electrochemical Reactions

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Power Generation And Storage

Solar Powered Carbon Dioxide (CO2) Conversion (TOP2-160)

A low-cost nanomaterial thin-film device

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Overview

NASA has developed a new technology that can convert the greenhouse gas carbon dioxide (C02) into fuel by using solar-powered, thin-film devices. Metal oxide thin films are fabricated to produce a photoelectrochemical cell that is powered by solar energy. By converting CO2 to fuel before it is emitted to the atmosphere this technology can mitigate the effects of the burning of fossil fuels, the worlds major fuel source for the foreseeable future This new nanomaterial thin-film device provides a low cost, facile fabrication pathway to commercialize the technology in the sustainable energy market. More importantly, it results in a zero carbon footprint by recycling C02 to fuels that are compatible with all existing fuel utilities. This is accomplished by using solar power to convert the C02 into a useable fuel in a very compact device.

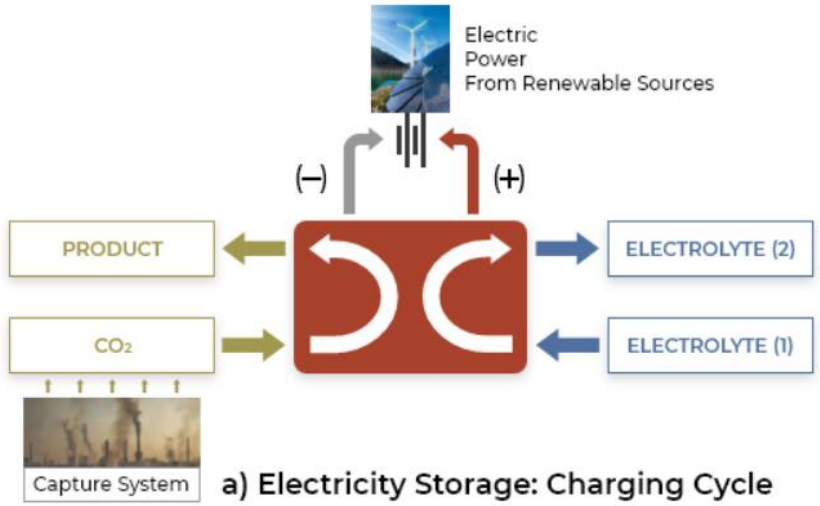
https://ntts-prod.s3.amazonaws.com/t2p/prod/t2media/tops/pdf/TOP2-160.pdf

Sustainable Energy from Electrochemical Reactions

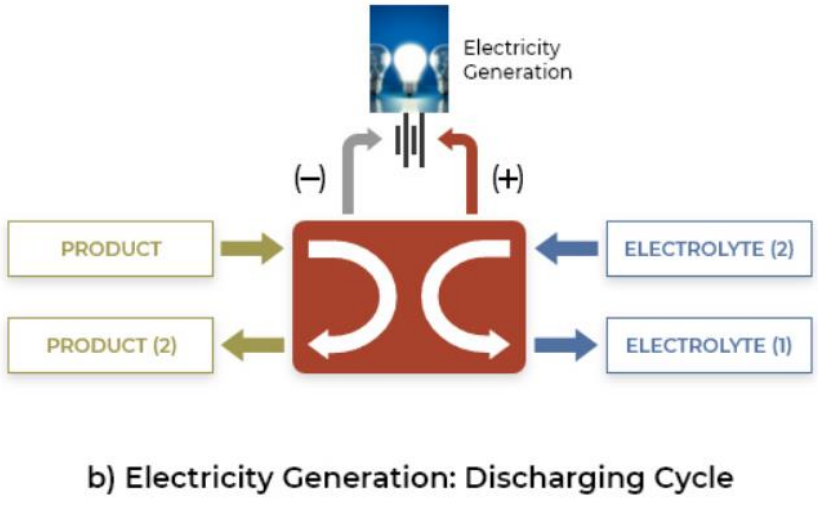
WHAT IS THE CO_2 REDOX FLOW BATTERY

Redox flow batteries are a class of electrochemical energy storage devices where chemical reduction and oxidation reactions (hence the name 'redox') that take place in the device enable the storage of energy. The name 'flow' refers to the fact that the electrolyte solutions are stored externally in separate tanks and flow continuously through a stack of electrochemical cells during operation.

One of the unique features of the CRB in the landscape of redox flow batteries is that, at battery negative electrode, the redox couple is CO_2 and its organic carbonaceous derivatives.



a) Electricity Storage: Charging Cycle



b) Electricity Generation: Discharging Cycle

Sustainable Energy from Electrochemical Reactions

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-High Efficiency
-Economic Investment
-Remote/Local Control Mode

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Hydrogen Plant by Water

https://verdellc.com/Hydrogen_Portable_Generator.asp

Sustainable Energy from Electrochemical Reactions

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BICHLOR DELIVERS SUPERIOR ELECTROLYSER EFFICIENCY

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BENEFITS

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Our state-of-the-art bipolar membrane electrolyser technology is installed in over 35 countries around the world, delivering significant energy savings and long-lasting performance over a lifetime of chlor-alkali production.

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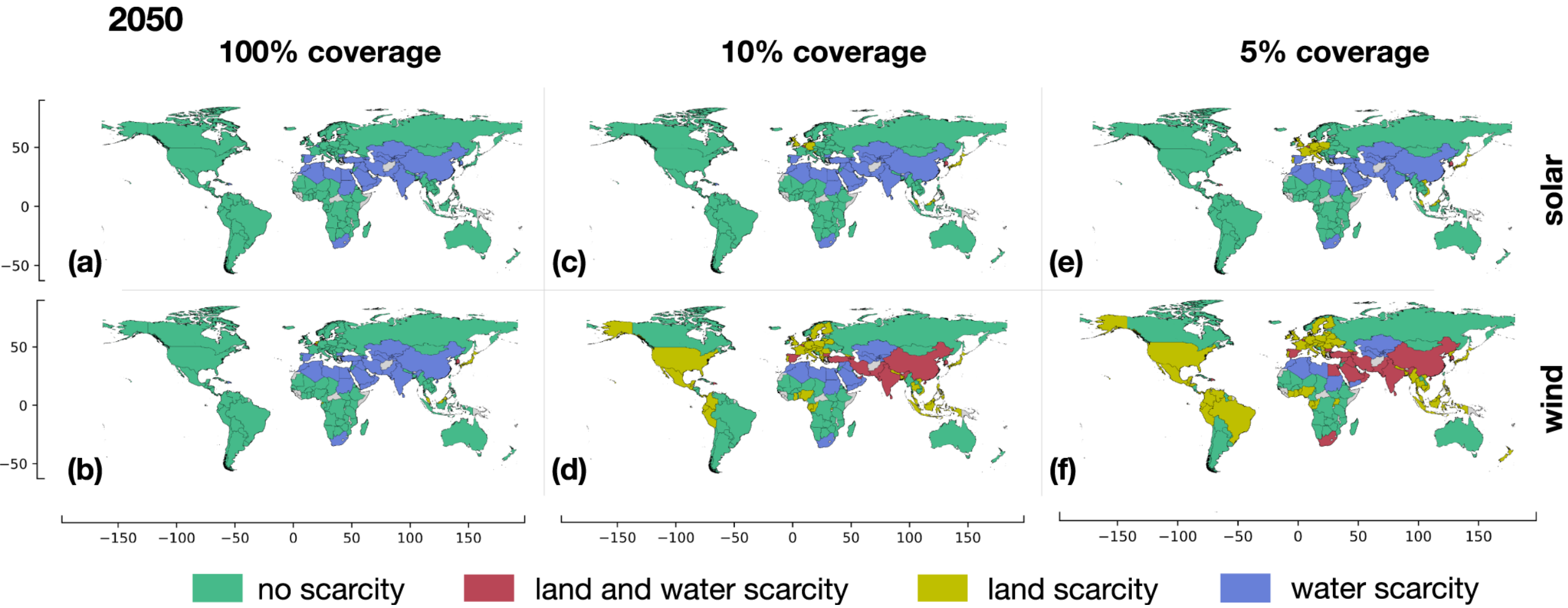
TOP

https://www.ineos.com/businesses/ineos-electrochemical-solutions/products/bichlor-electrolyser

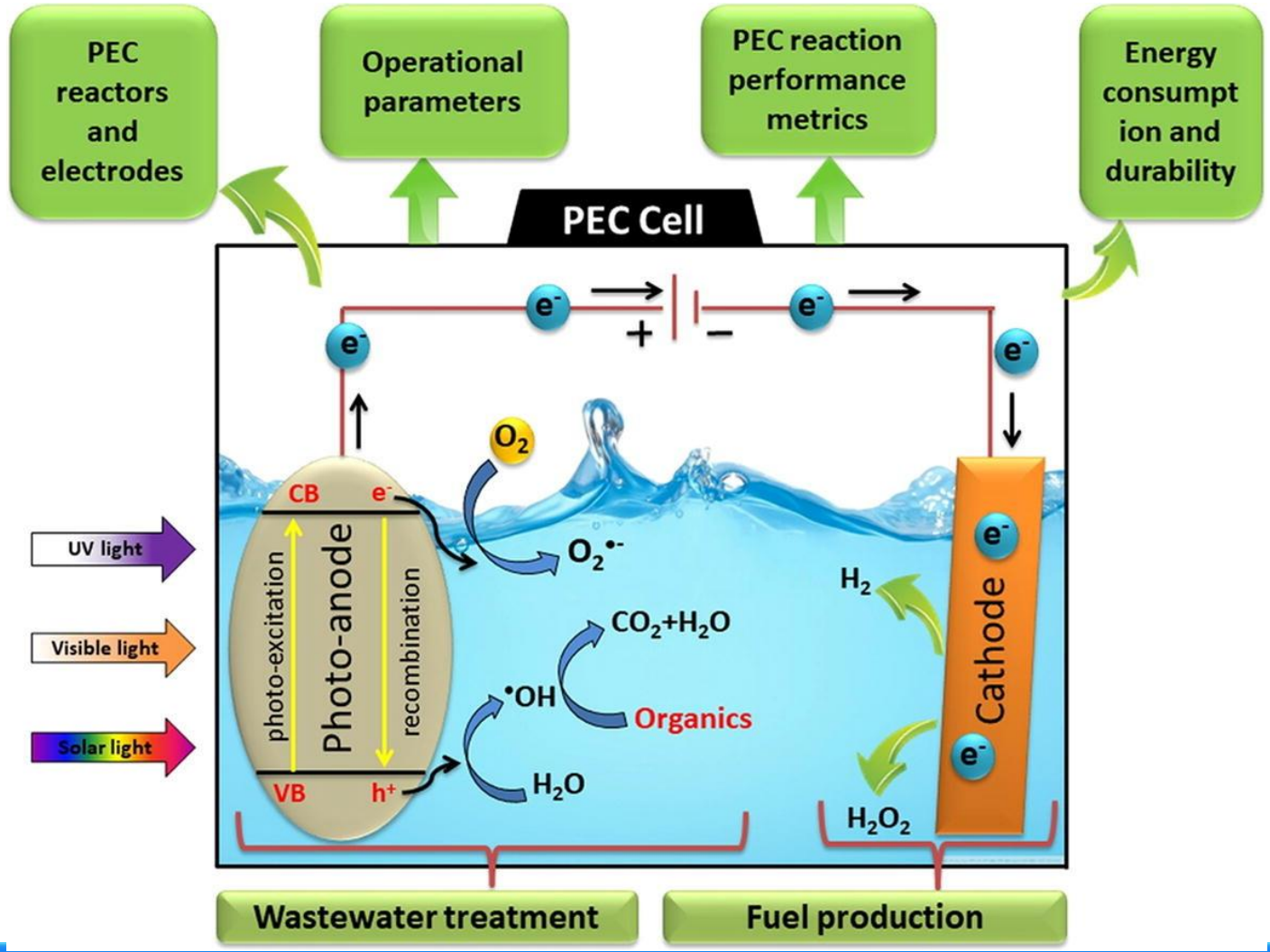
The Problem? Water!



The Solution? Join the Reactions!

The combination of Water Treatment and Energy Production

- ✓ reduce the cost of both demands
- ✓ synthesis of green sources of energy
- ✓ appropriated management of industrial waste.



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Electrochimica Acta 306 (2019) 277–284

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Electrochimica Acta

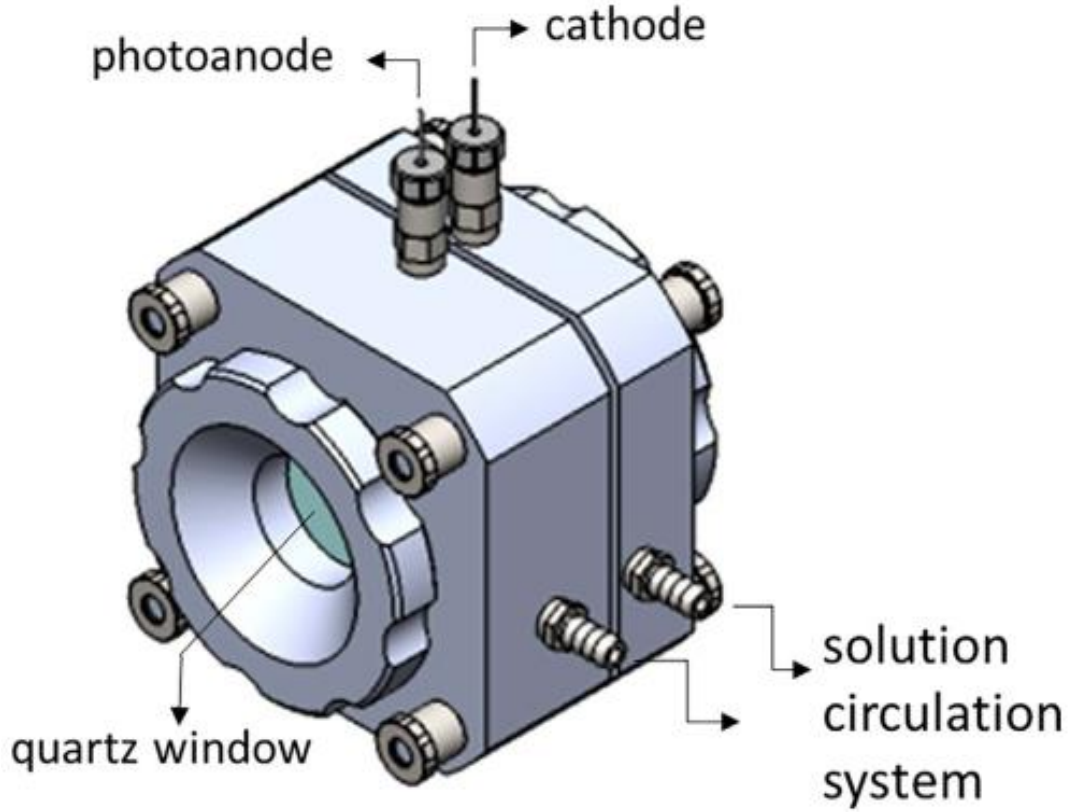
journal homepage: www.elsevier.com/locate/electacta

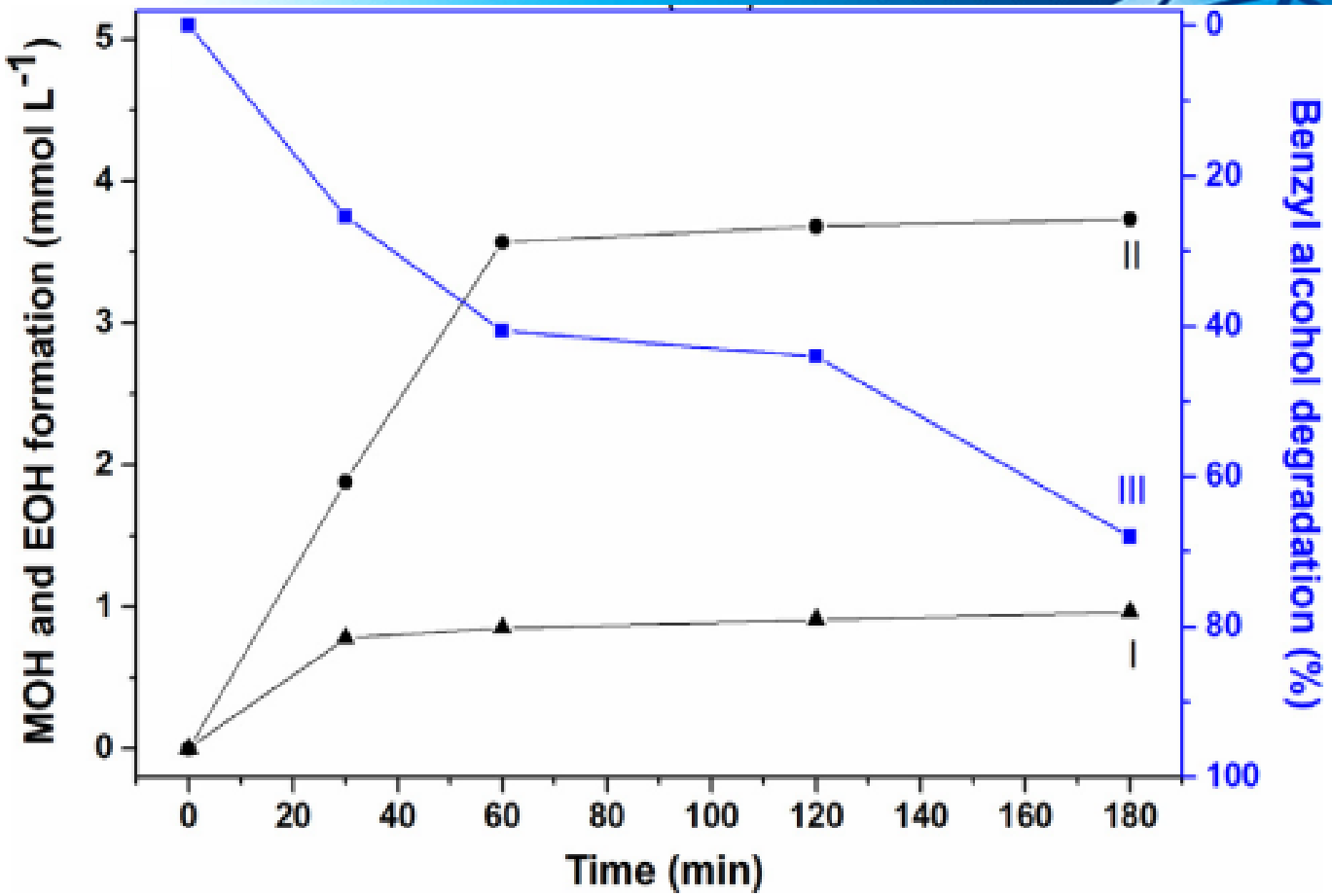
Turning carbon dioxide into fuel concomitantly to the photoanode-driven process of organic pollutant degradation by photoelectrocatalysis

Juliana Ferreira de Brito [a, b, *], João Angelo Lima Perini [a], Siglinda Perathoner [b], Maria Valnice Boldrin Zanoni [a, **]

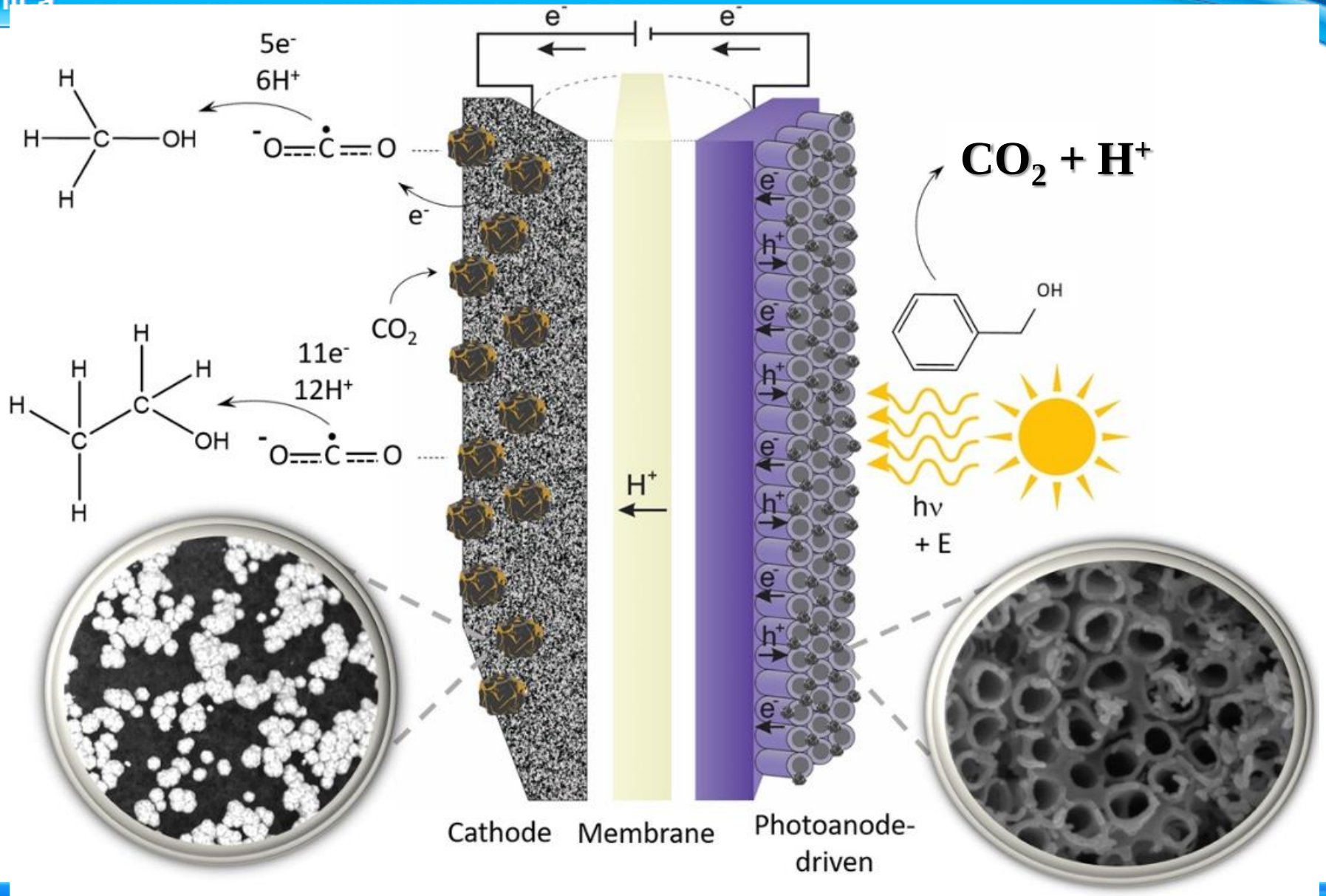
[a] Univ. Estadual Paulista (Unesp), Instituto de Química, Araraquara. Av. Prof. Francisco Degni, 55, 14800-060, Araraquara, SP, Brazil
[b] Univ. of Messina, ERIC aisbl and CASPE/INSTM, Departments ChiBioFarAm and MIFT, viale F. Stagno d'Alcontres 31, 98166, Messina, Italy

- **GDL-Cu_2O;**
- **TiO_2 Nt-ZrO_2.**



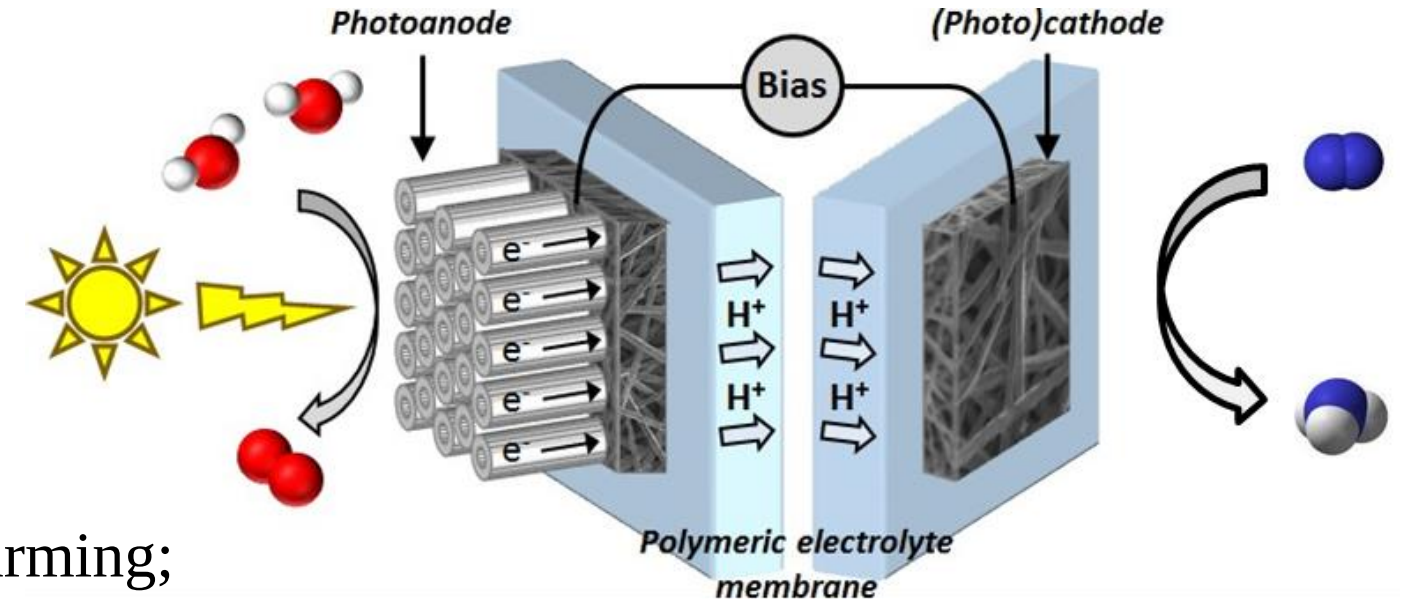


Benzyl alcohol degradation (III) concomitant to methanol (II) and ethanol (I) formation from CO_2 reduction under UV-Vis light and an applied bias of 1.5 V using GDL-Cu_2O as the cathode and TiO_2Nt-ZrO_2 as photoanodes.


e⁻
e⁻
5e⁻
6H⁺
H
H
C
OH
H
O
C
O
e⁻
CO₂
11e⁻
12H⁺
H⁺
hν
+ E
CO₂ + H⁺
OH
Cathode
Membrane
Photoanode-
driven

Possible catalysts includes:

- WO_3-$BiVO_4$;
- TiO_2-NiO and TiO_2-CuO;
- TiO_2-B
- MoS_2 and MoS_2-CuO



Possible water treatment includes:

- Agro-industrial wastewater from fruit farming;
- Effluents containing drugs (antidepressants such as Venlafaxine)
- Water contaminated by pesticides (such as atrazine)

Energy generation:

- H_2 production;
- N_2RR;
- CO_2RR

CONCLUSION

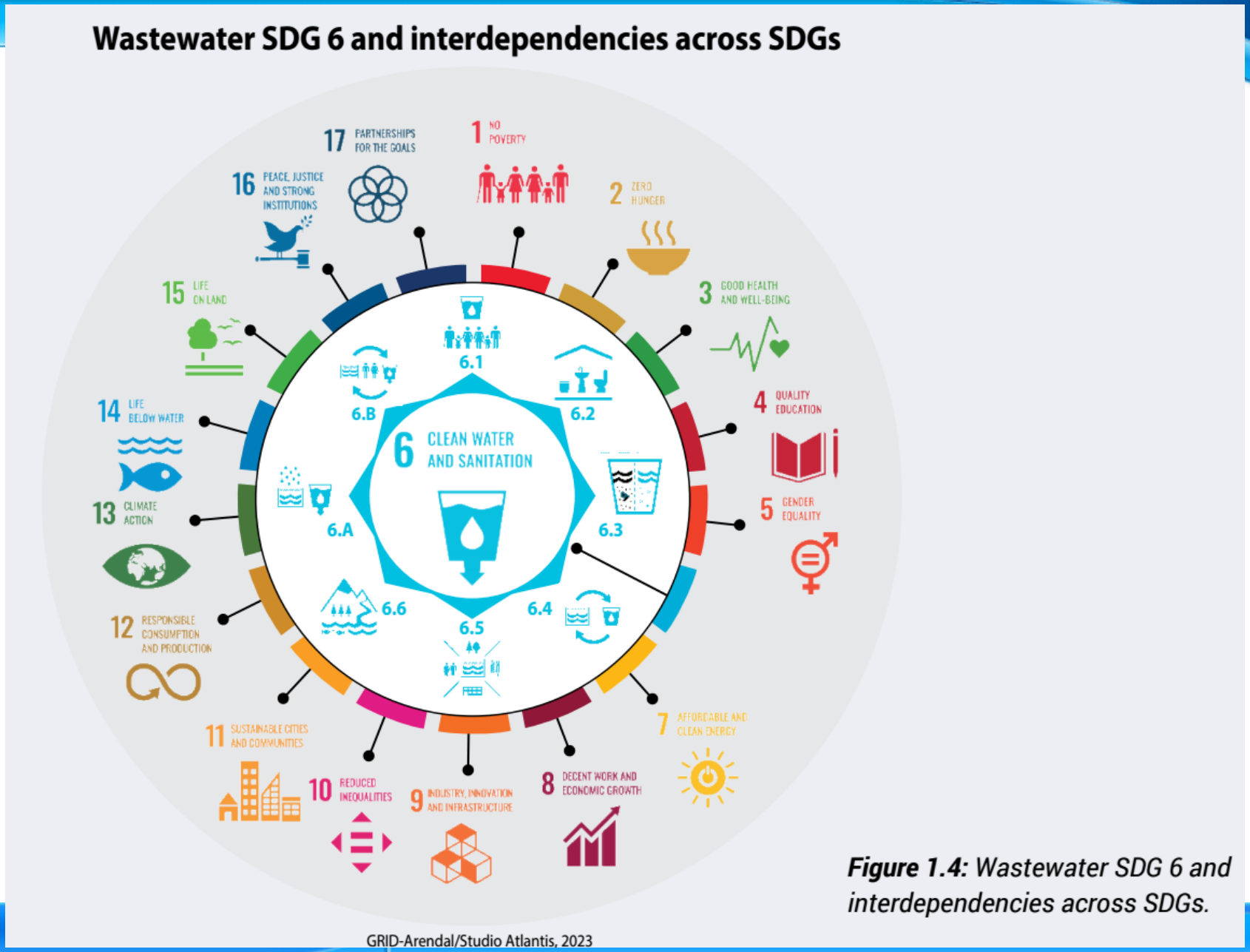


Figure 1.4: *Wastewater SDG 6 and interdependencies across SDGs.*

serrapilheira

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Conselho Nacional de Desenvolvimento Científico e Tecnológico

CAPES

Thank you!

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