ELECTRO-REDUCCIÓN DE CO_2 CON NANOMATERIALES AVANZADOS: HACIA ELECTROCATÁLISIS MÁS SELECTIVAS Y ESTABLES

Beatriz Ávila Bolívar

Directores: José Solla Gullón

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XL Reunión del Grupo de Electroquímica de la Real Sociedad Española de Química.

Huelva, Julio 2019

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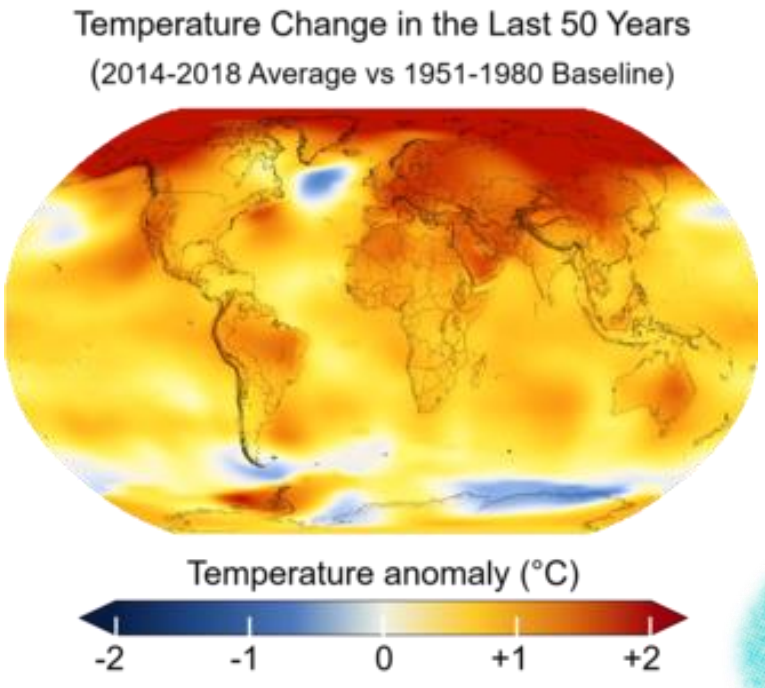
Cambio climático



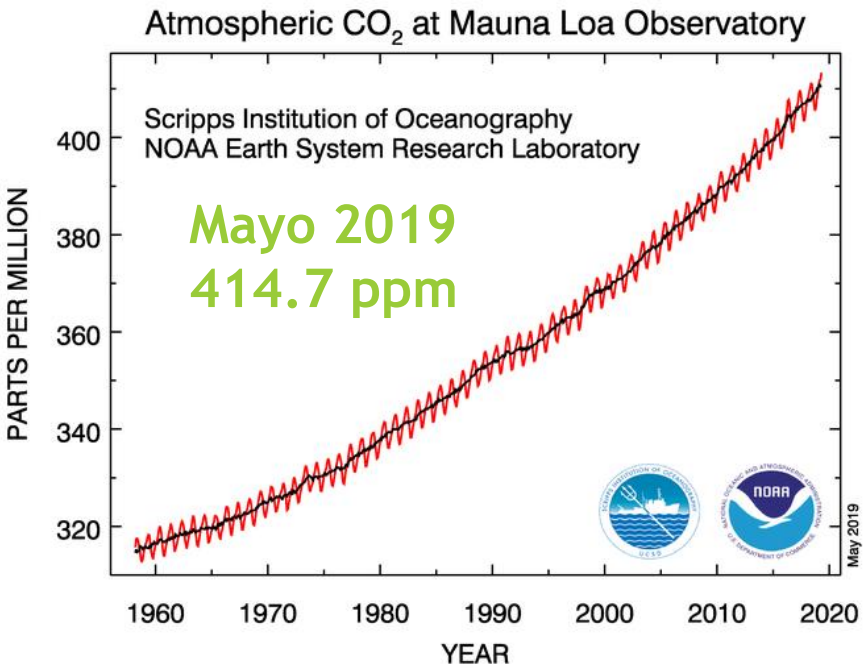
climate.nasa.gov

Deshielo en Groenlandia Junio 2019 (foto de Steffen Malskaer)

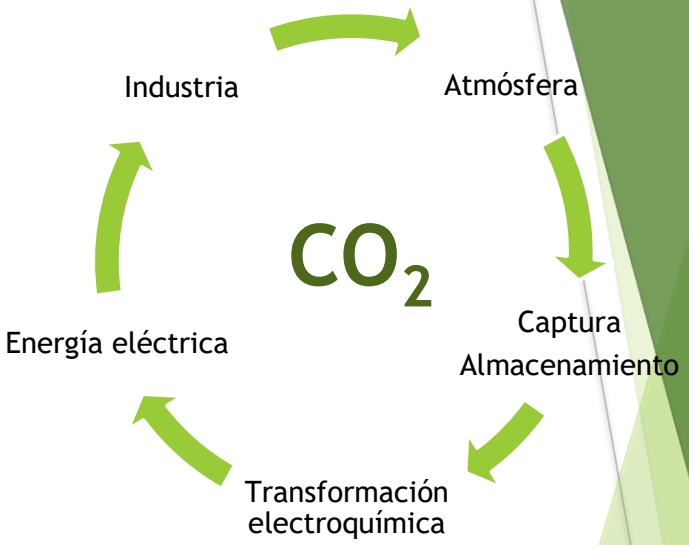
Acuerdo de París 2015, 195 países

Introducción

Dióxido de carbono



Mauna Loa, Hawaii en marzo de 2019



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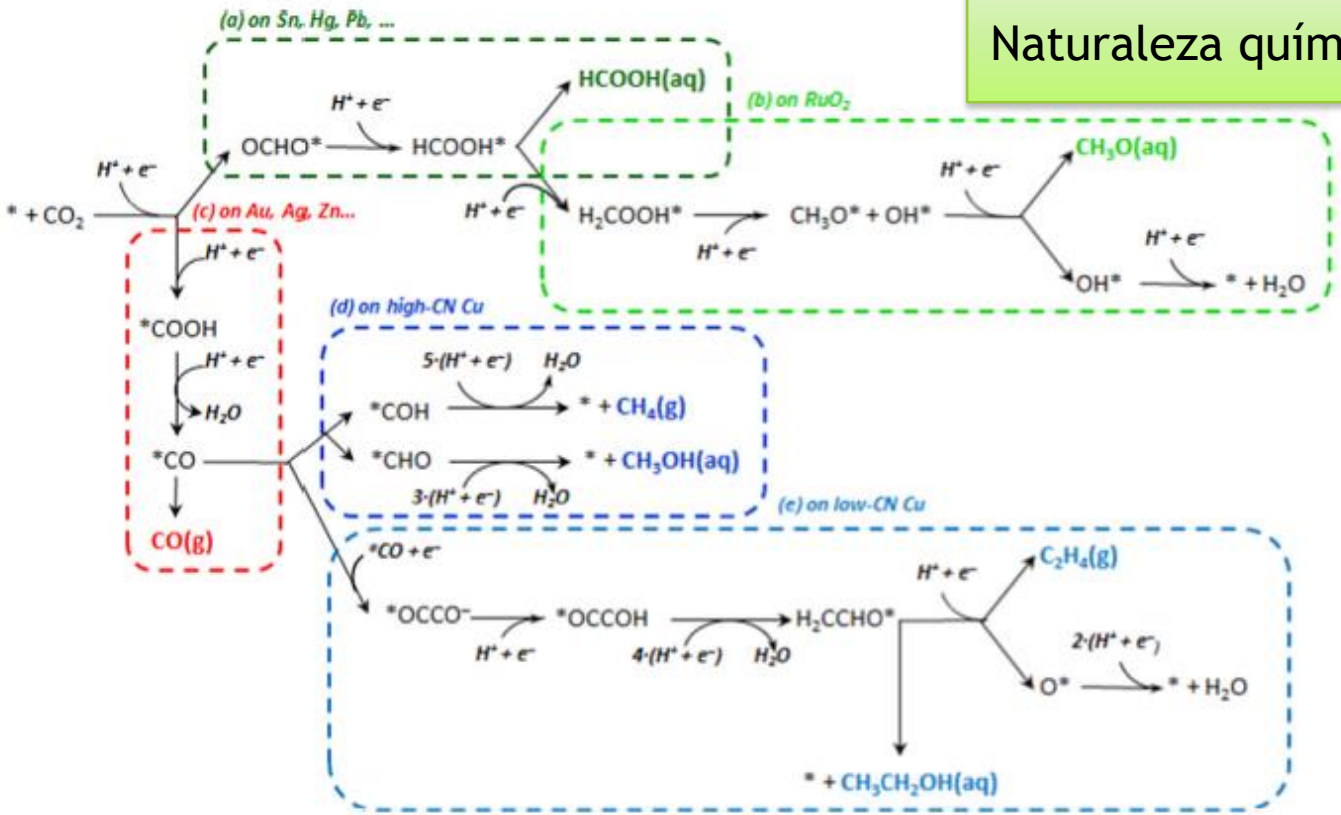
Introducción

Antecedentes

Naturaleza química



Schmidt, T. J., Herranz J., Durst J., Nano Energy 2016

Introducción
Antecedentes

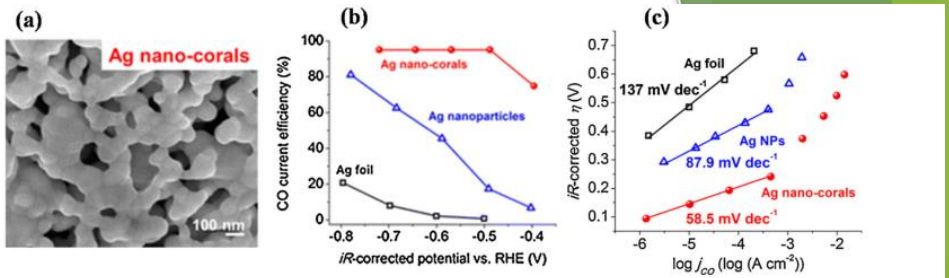


Fig. 5. CO_2 reduction performance of Ag nano-corals.
(a) SEM image of Ag nano-corals, (b) the current (or faradaic) efficiency vs. potential and (c) overpotential vs. current density (Tafel) plots for Ag foil, nanoparticles, and nano-corals [122].

Y.-C. Hsieh et al., ACS Catal. 5 (2015) 5349-5356

- Bulk vs nano
- Tamaño y morfología de partícula
- Composición del electrolito
- Estructura superficie
- Oxidación

Table 5 Faradaic efficiencies of the products in the electrochemical reduction of CO_2 in various 0.1 M hydrogencarbonate solutions[a]

Electrolyte	Potential/ V versus SHE	Faradaic efficiency (%)								C_1/C_2
		CH_4	C_2H_4	CO	EtOH	PrOH	$HCOO^-$	H_2	Total	
$LiHCO_3$	−1.45	32.2	5.2	tr	1.6	tr	4.7	60.5	104.2	6.19
$NaHCO_3$	−1.45	55.1	12.9	1.0	4.2	0.6	7.0	25.1	105.9	4.27
$KHCO_3$	−1.39	32.0	30.3	0.5	10.9	1.6	8.3	14.5	98.1	1.06
$CsHCO_3$	−1.38	16.3	30.5	2.4	7.2	4.4	15.8	24.4	101.0	0.53

[a]Current density: 5.0 mA cm^{-2}. Temperature: 18.5 °C

R.M. Aran-Ais et al., Acc. Chem. Res. (2018), 51, 2906−2917

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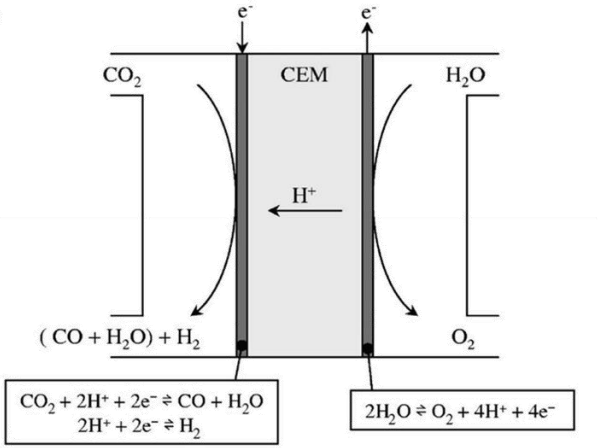
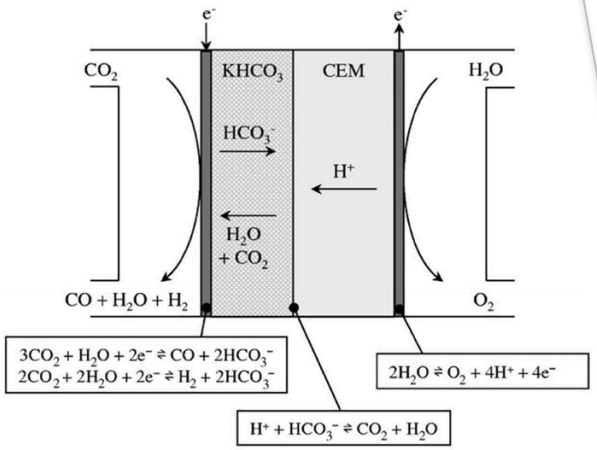
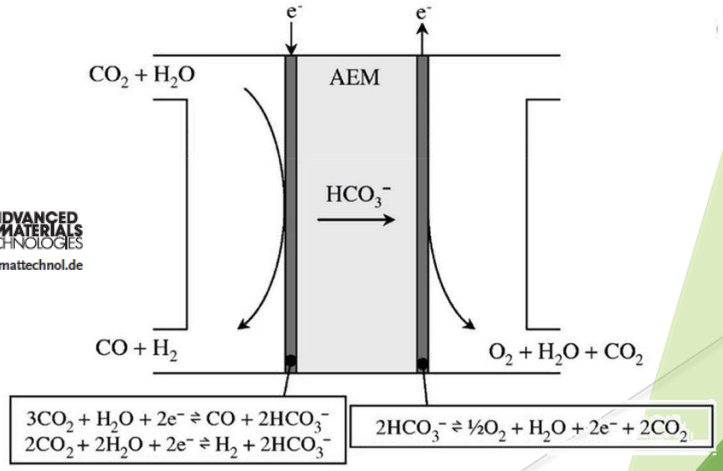
Antecedentes





Configuración electroquímica



REVIEW
CO2 Reduction

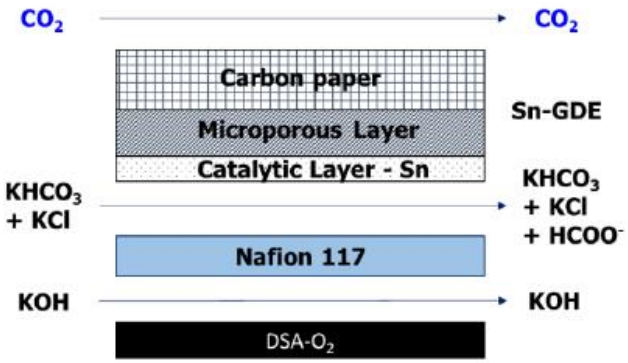
ADVANCED MATERIALS TECHNOLOGIES
www.advmattechnol.de

Design of Electrocatalysts and Electrochemical Cells for Carbon Dioxide Reduction Reactions

*Wanfeng Yang, Kamran Dastafkan, Chen Jia, and Chuan Zhao**

Introducción

Antecedentes del grupo



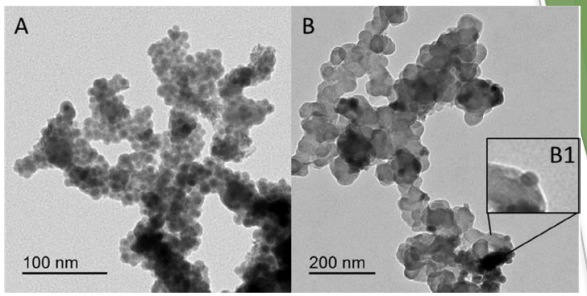


Fig. 2. TEM images. (A) Sn pure particles. (B and B1) Sn carbon supported particles.

Journal of CO_2 Utilization 18 (2017) 222–228

Contents lists available at ScienceDirect

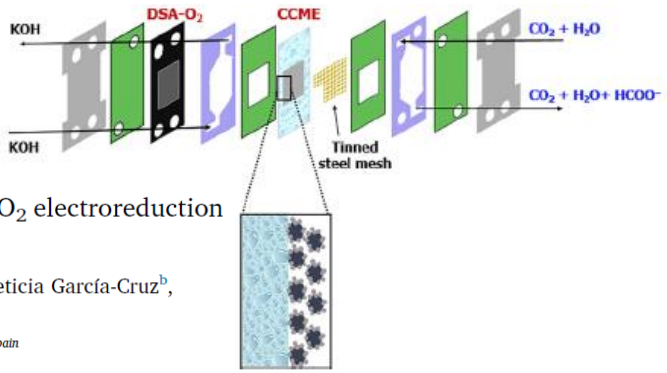
Journal of CO_2 Utilization

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

Sn nanoparticles on gas diffusion electrodes: Synthesis, characterization and use for continuous CO_2 electroreduction to formate

A. Del Castillo [a,*], M. Alvarez-Guerra [a], J. Solla-Gullón [b], A. Sáez [b], V. Montiel [b], A. Irabien [a]

[a] Universidad de Cantabria, Dep. Chemical and Biomolecular Engineering, ETSIIT, Avda. Los Castros s/n, Santander 39005, Spain
[b] Institute of Electrochemistry, University of Alicante, Ap. 99, Alicante 03080, Spain



Catalyst coated membrane electrodes for the gas phase CO_2 electroreduction to formate

Guillermo Díaz-Sainz[a,*], Manuel Alvarez-Guerra[a], José Solla-Gullón[b], Leticia García-Cruz[b], Vicente Montiel[b], Angel Irabien[a]

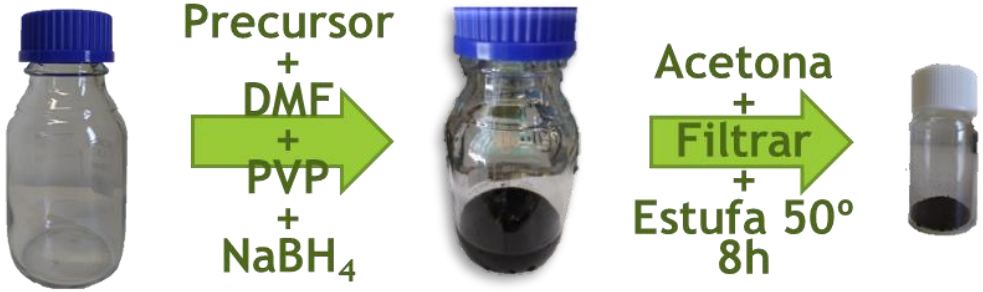
[a] University of Cantabria, Dep. Chemical and Biomolecular Engineering, ETSIIT, Avda. Los Castros s/n, Santander 39005, Spain
[b] Institute of Electrochemistry, University of Alicante, Ap. 99, Alicante 03080, Spain

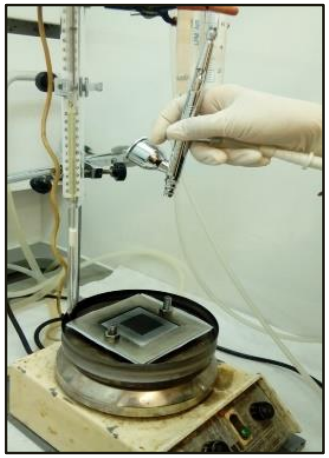
Fig. 2. Electrochemical membrane reactor and electrode configuration.

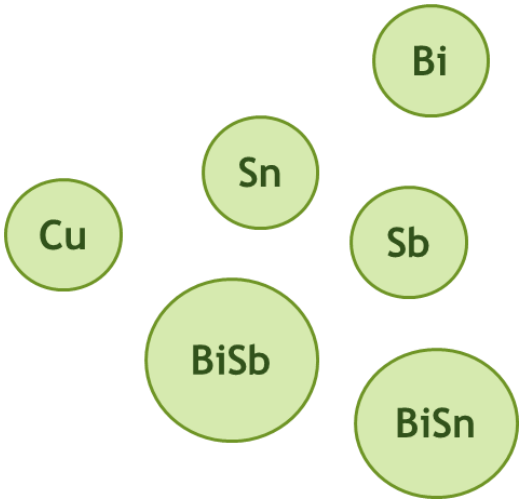
Díaz-Sainz, G., Catalysis Today, https://doi.org/10.1016/j.cattod.2018.11.073

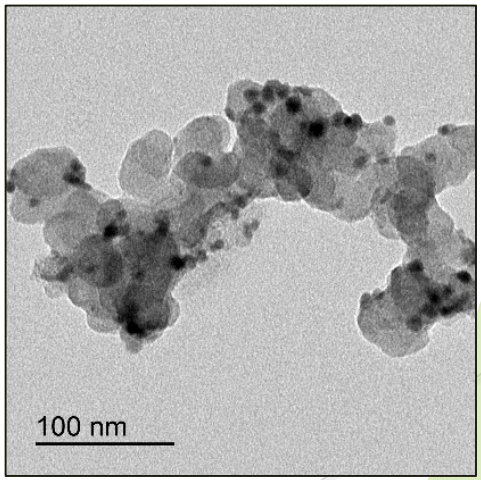
Objetivos

Electrocatalizadores





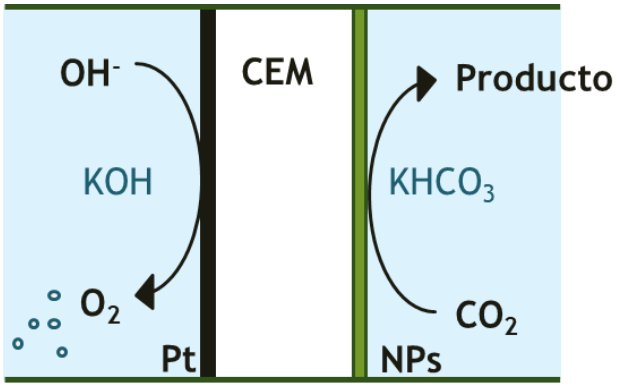




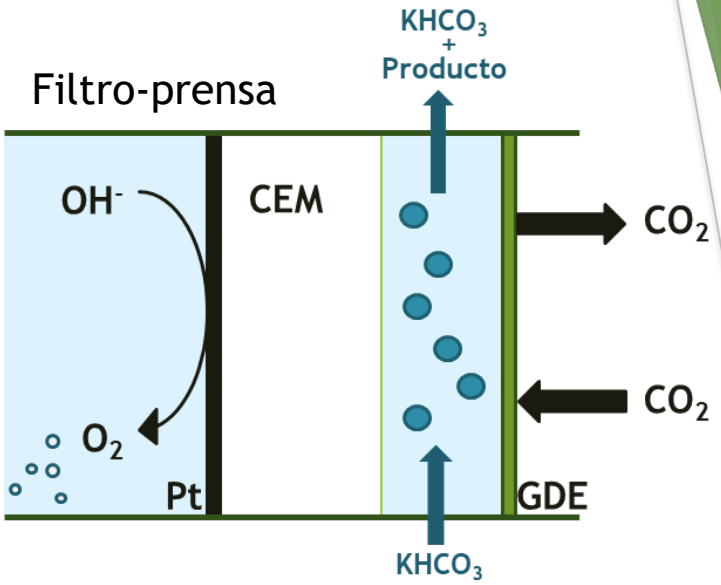
Objetivos

Configuraciones

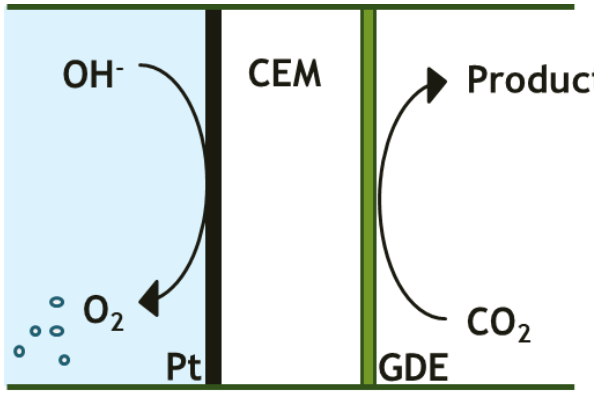
H-Cell



Filtro-prensa



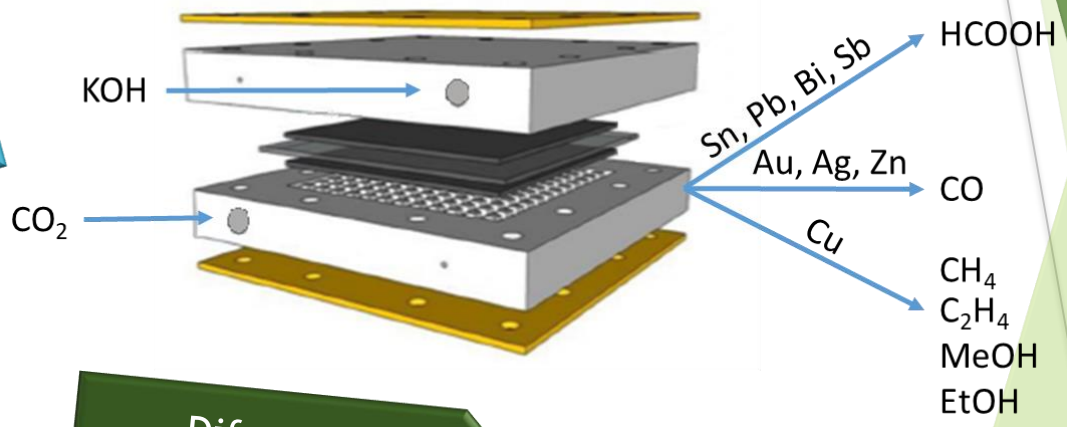
PEMER



Objetivos

Nuevos electrocatalizadores efectivos, selectivos y estables

Reducción a bajos sobrepotenciales y en presencia de agua

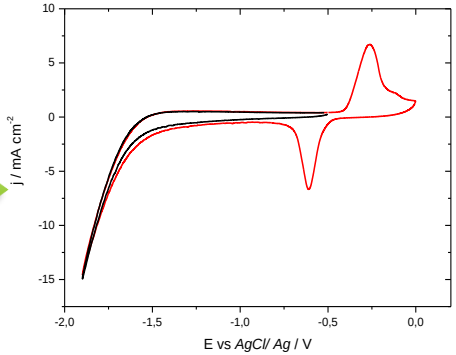


Diferentes configuraciones electroquímicas

Metodología

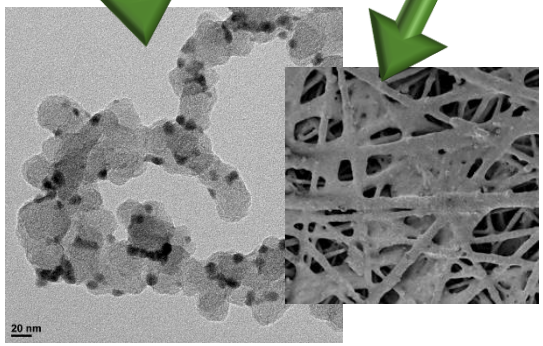
Síntesis NPs

Fabricación del electrodo

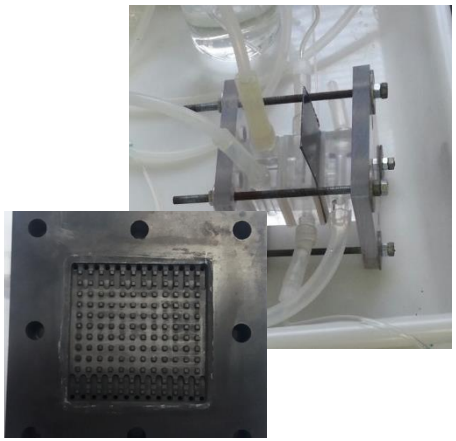


Caracterización electroquímica

Viabilidad del proceso



Caracterización química física (TEM, SEM, XPS, XRD)



Escalado

Análisis productos

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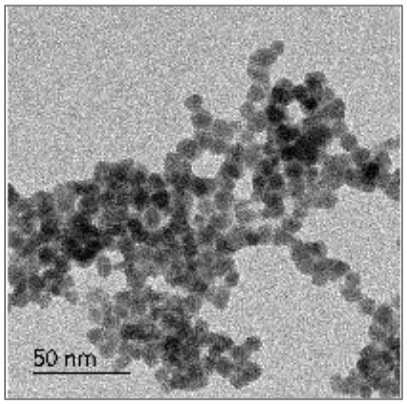
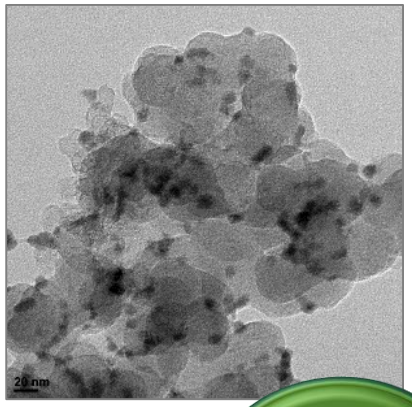
Plan de trabajo

1. Síntesis de nanoparticulas	• Preparación de nanopartículas de Bi, Sb y aleaciones (disolventes, soportadas o no, control de tamaño, etc.)
2. Fabricación de electrodos	• Caracterización química física de los electrocatalizadores.
3. Comportamiento electrocatalítico	• Caracterización electroquímica: distintos sistemas potenciostato-galvanostato.
4. Reactores electroquímicos	• Diferentes configuraciones y reactores electroquímicos: tipo de membranas, electrolitos, reactores tipo filtro prensa, PEMER, etc.

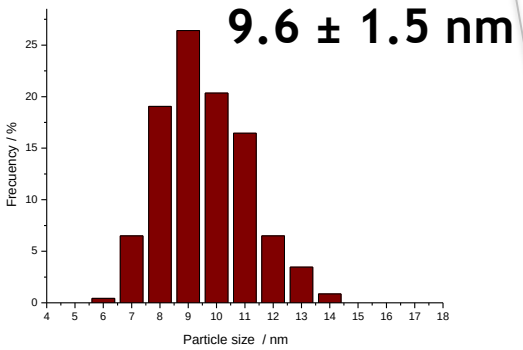
Resultados iniciales



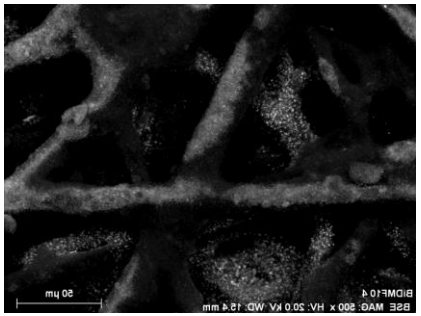
Bi

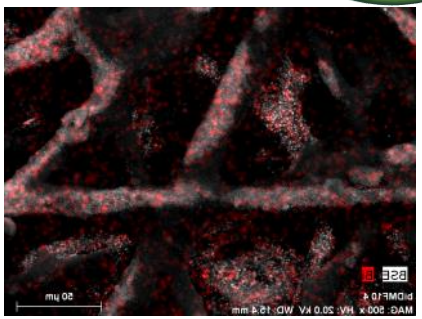


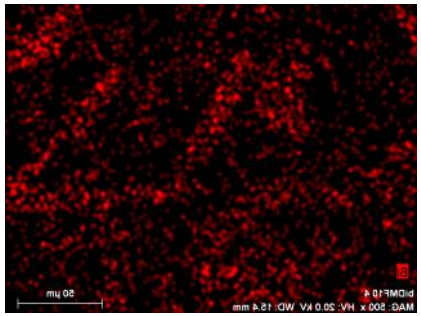
Bi/C



Bi







SEM-EDX mapping (Hitachi) Electrodo Bi/C

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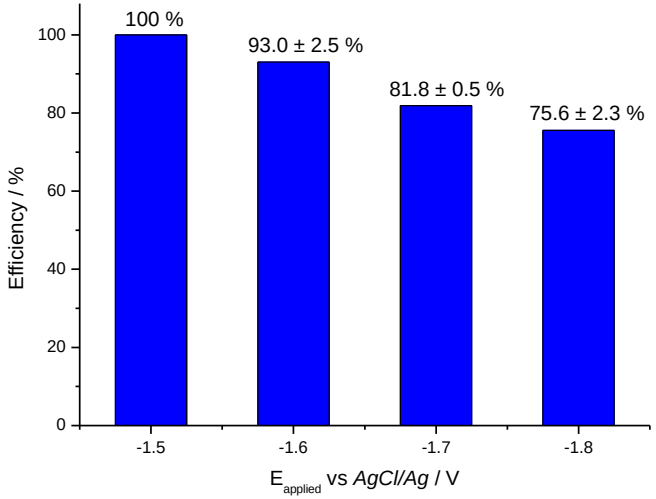
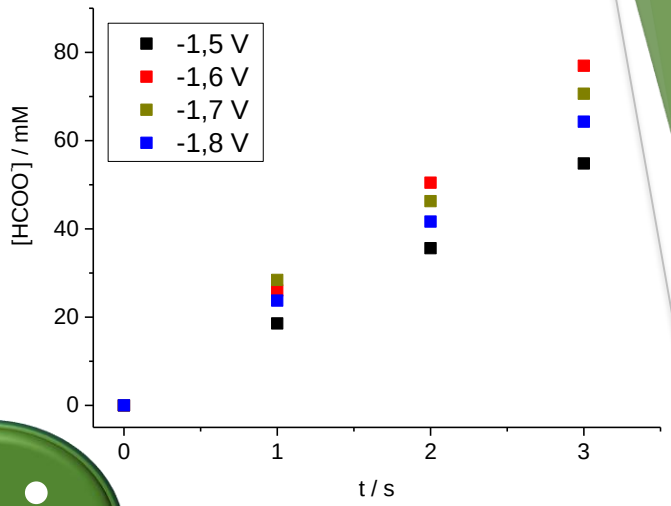
Resultados iniciales





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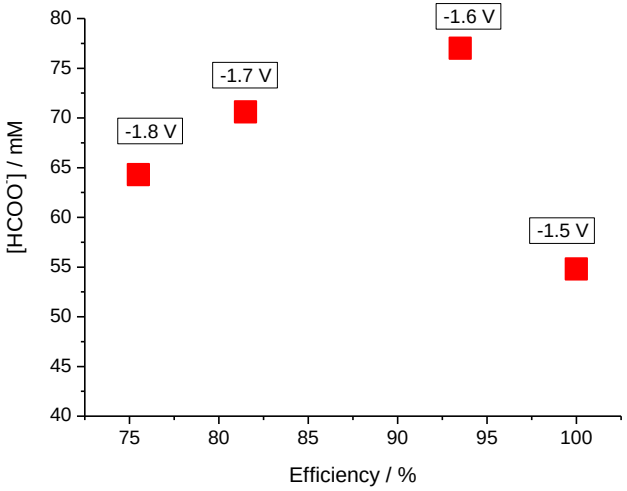

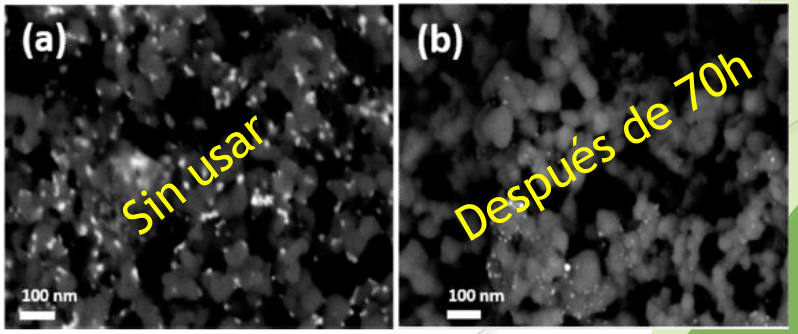

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