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Booklets

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Title: Non-noble metal electrocatalysts for fuel cell applications

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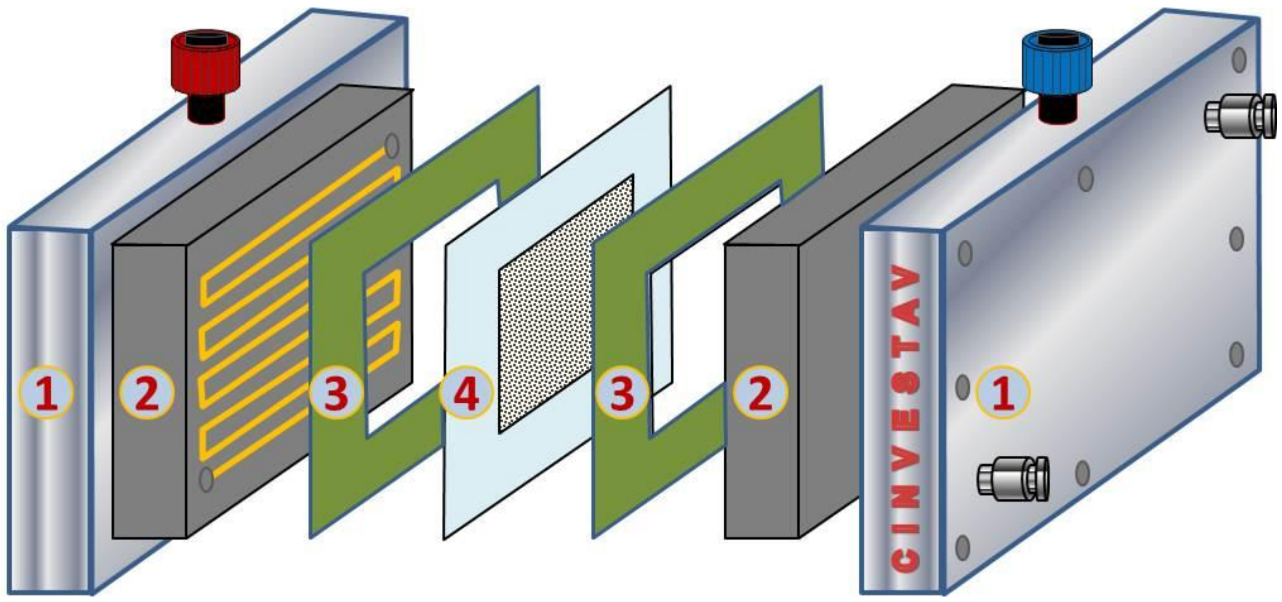
1. Introduction

Fuel cell

The Fuel Cell (FC): The FC are electrochemical devices that convert the intrinsic chemical energy of a fuel to direct electrical energy.



1) Current collectors
2) Bipolar plates
3) Seals
4) Membrane electrode assembly.

1. Introduction

Fuel cell

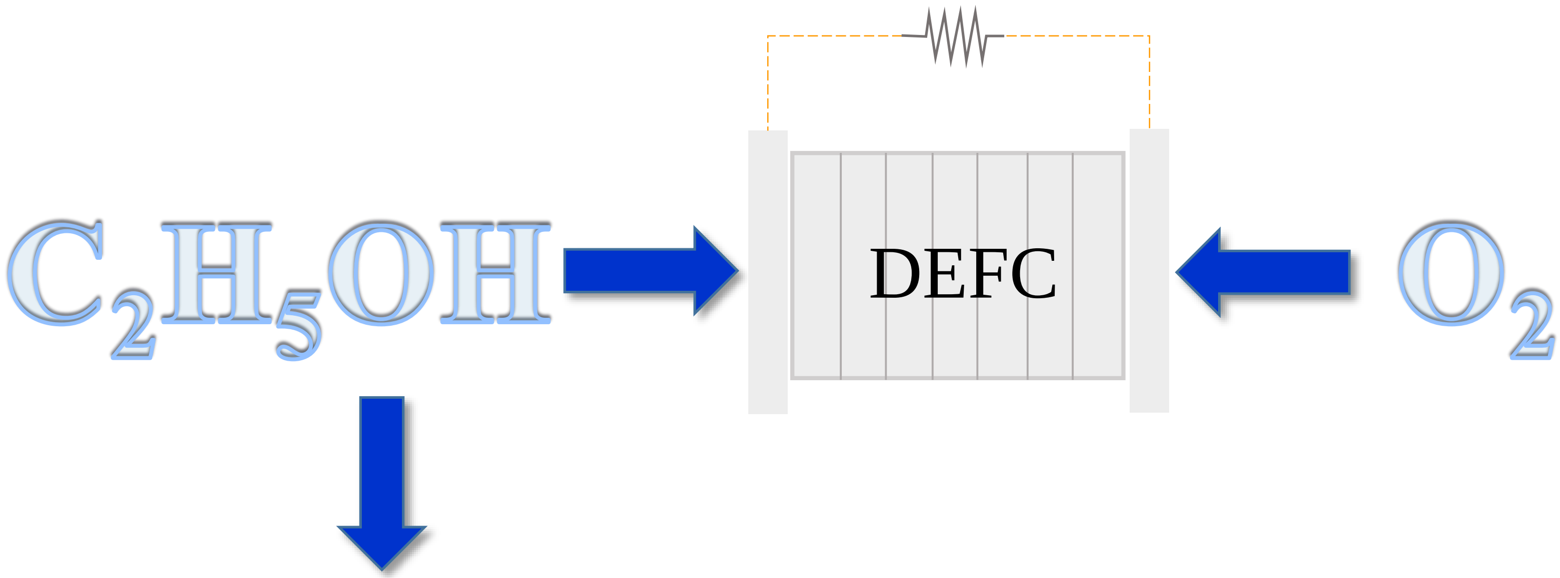
1.6 Drawbacks of DEFCs

- High costs
- Low efficiencies
- Corrosion

Low efficiencies → physical phenomena / Electrochemical phenomena

Fuel cell

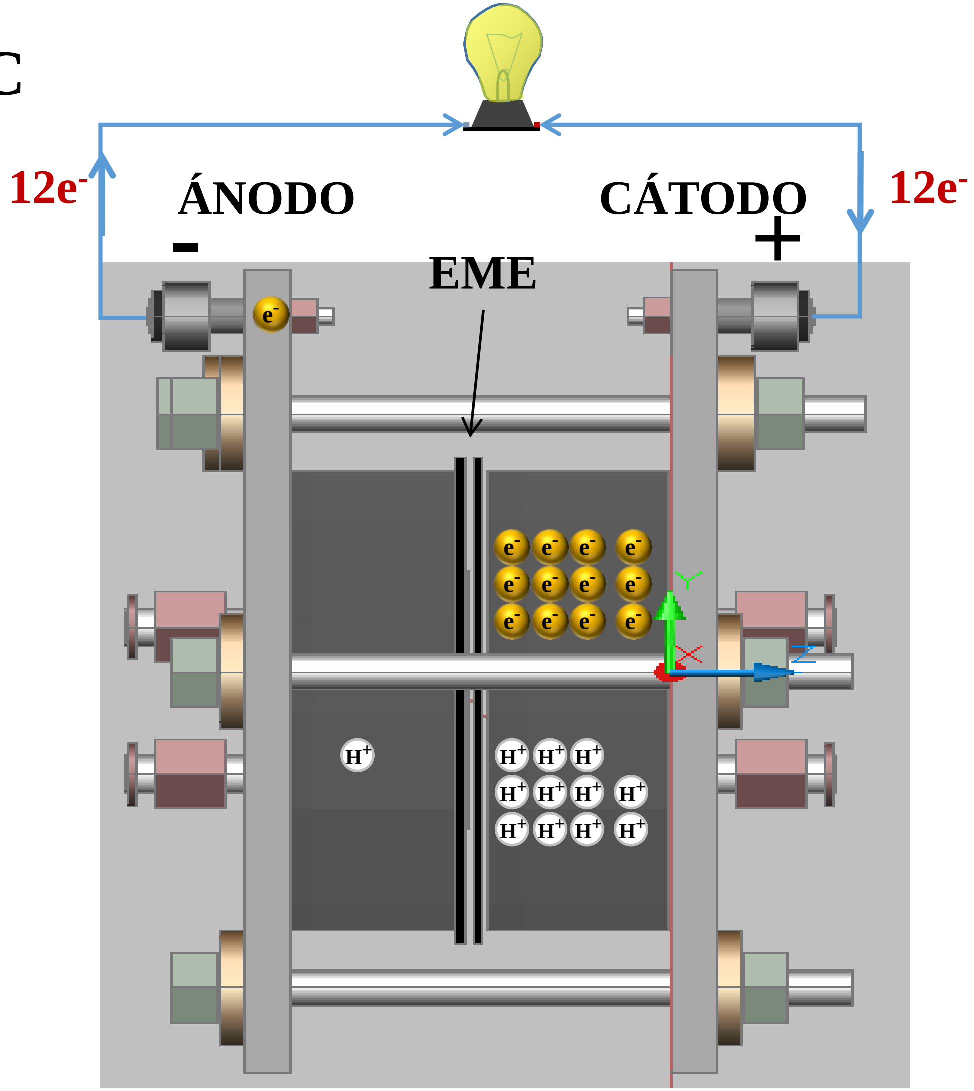
1.3. The alcohol Fuel Cell



- ❑ The use of liquid fuels such as alcohols
- ❑ Fermentation of raw materials
- ❑ Gasoline infraestructura

2. Background

2.1 Operating principle of a DEFC



Anode reaction:	$CH_3CH_2OH + 3H_2O \rightarrow 2CO_2 + 12H^+ + 12e^-$	E=0.085 V
Cathode reaction:	$3O_2 + 12H^+ + 12e^- \rightarrow 6H_2O$	E=1.229 V
Global reaction:	$CH_3CH_2OH + 3O_2 \rightarrow 2CO_2 + 3H_2O$	E=1.144 V

2. Background

2.2 Electrocatalysts

PtM/C

⇓

Sn, Mo, Ru.

The polyol method
- **Traditional heating**
  - Larger reaction time
- **IMH**
  - Shorter reaction time
  - Homogeneous nucleation
  - Narrow particle size distribution

- **Non-precious metals-based catalysts:**

PtM/C

⇓

Ni, Mo, Co.

2. Background

2.2 Non- noble metal electrocatalysts

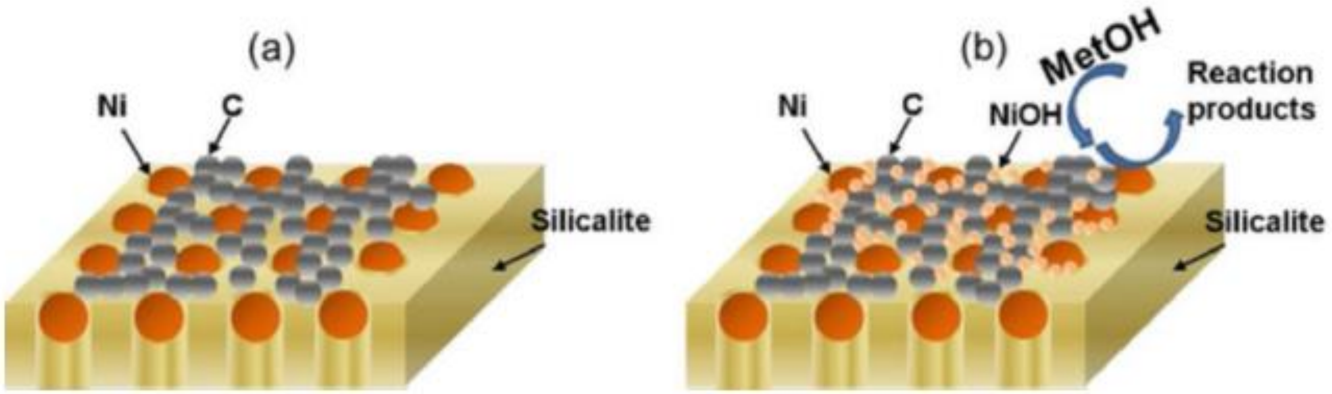


Fig. 8.2 Schematic diagram of silicalite–Ni–C structure: (a) without $NiSO_4$, and (b) presoaked in $NiSO_4$ solution

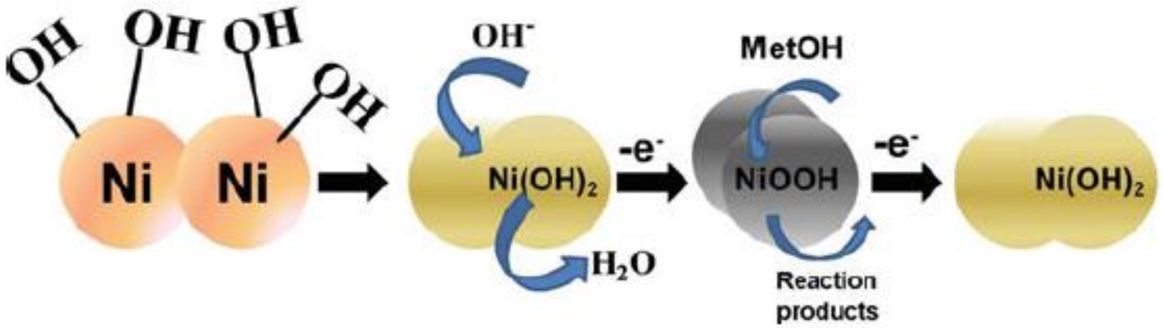


Fig. 8.3 Mechanism of reaction for methanol in Ni electrode in alkaline media

Chapter 8
Non-Noble Metal as Catalysts for Alcohol Electro-oxidation Reaction

Samuel Dessources, Diego Xavier del Jesús González-Quijano, and Wilian Jesús Pech-Rodríguez

2. Background

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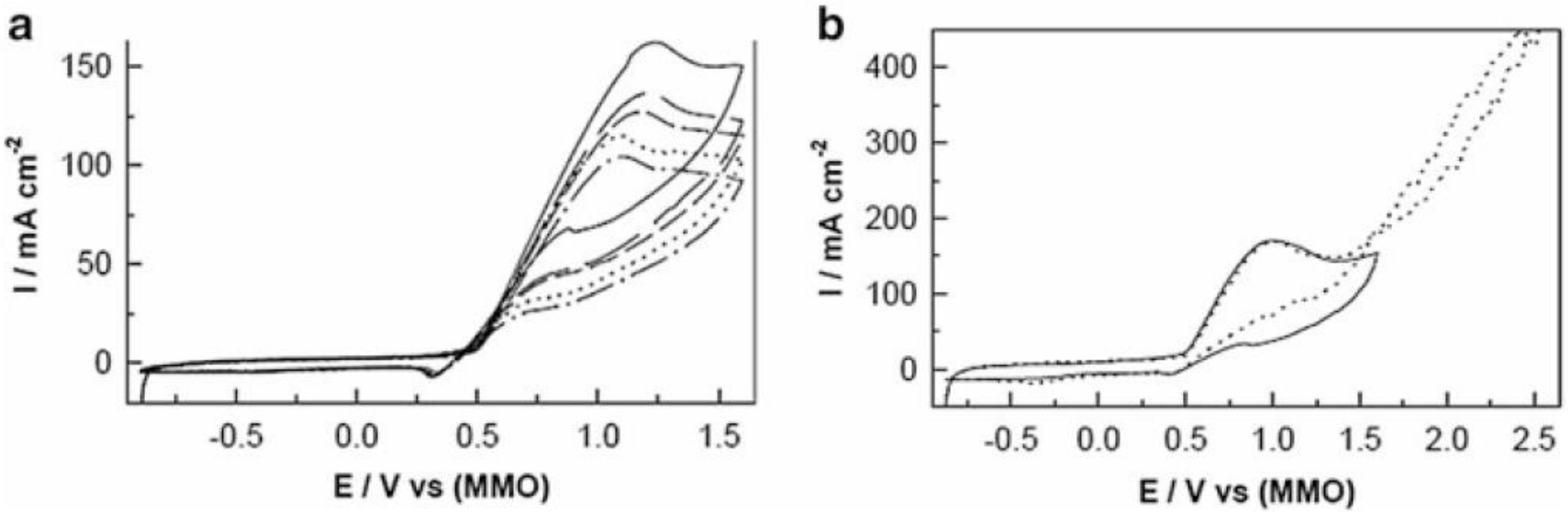

Fig. 8.5 (**a**) Cyclic voltammogram of the MOR on C/Ni electrode at 50 mV s^{-1}, and (**b**) effect of the extended potential on the MOR. Scan rate: 50 mV s^{-1}. Adapted with permission from Ref. [26]. Copyright 2004 Elsevier

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2. Background

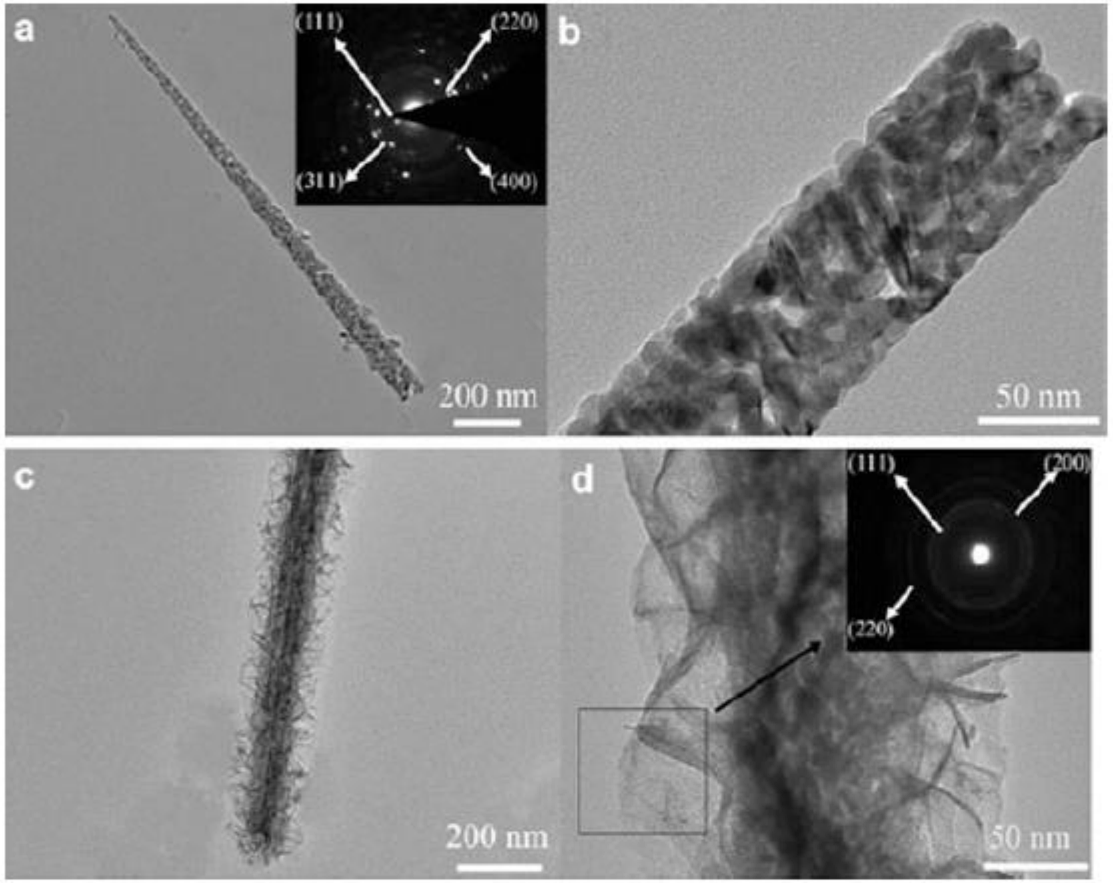

Fig. 8.11 TEM images of (a, b) Co_3O_4 nanowire (SAED pattern in inset) and (c, d) Co_3O_4/NiO core/shell nanowire (SAED pattern in inset). Copyright 2013 Elsevier [47]

Chapter 8
Non-Noble Metal as Catalysts for Alcohol Electro-oxidation Reaction

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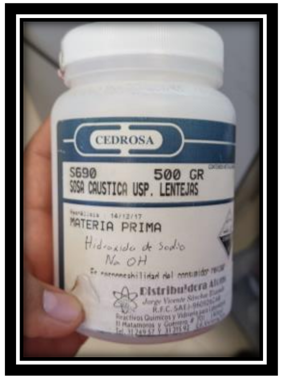
3. Experimental methods

3.1 method for the synthesis of electrocatalysts

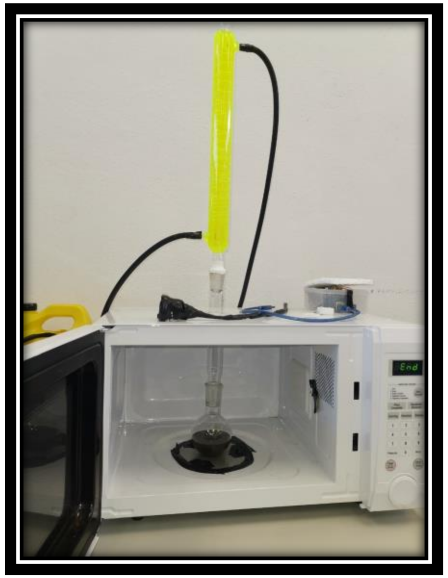
Ethylene glycol

$NiCl_2$ carbon XC-72

Sodium hydroxide(NaOH)



Microwave irradiation



Filtred and dried.

3. Experimental methods

3.2 Physical characterization

- Ni nanoparticles were characterized by X-Ray measurements on a Phillips-X´Pert diffractometer using Cuka radiation (l= 0.15406 nm) with a working voltage of 40 kV.

- FTIR measurements were conducted in a WQF-510A FTIR Rayleígh instrument in transmission mode using KBr pellets.

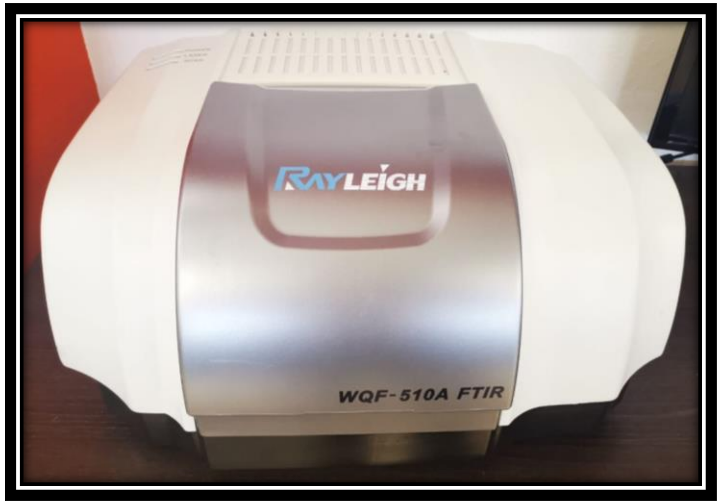


Figure 8. FVelocity simulation along the simple serpentine gas flow channel in PST Results.s

4. Results and discussions

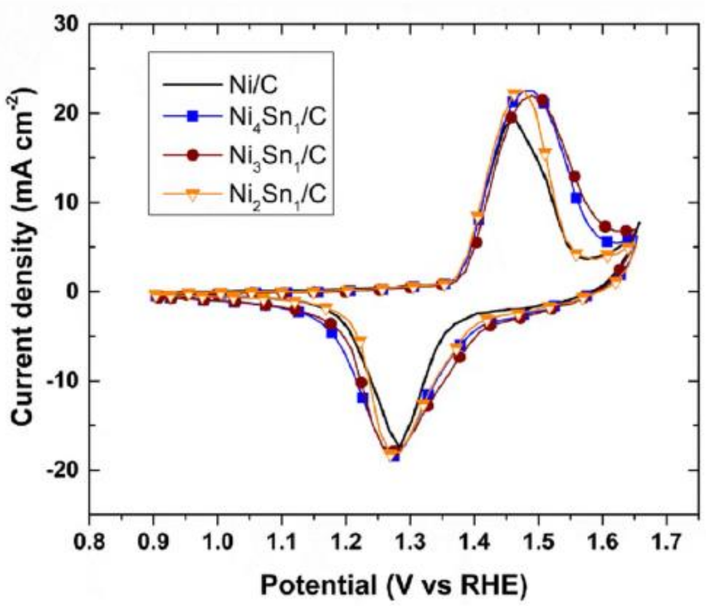


Figure 4: Cyclic voltammetry curves of Ni/C and NiSn/C at scan rate of 20 mV s^{-1} collected in a electrolyte of 0.5 mol L^{-1} NaOH.

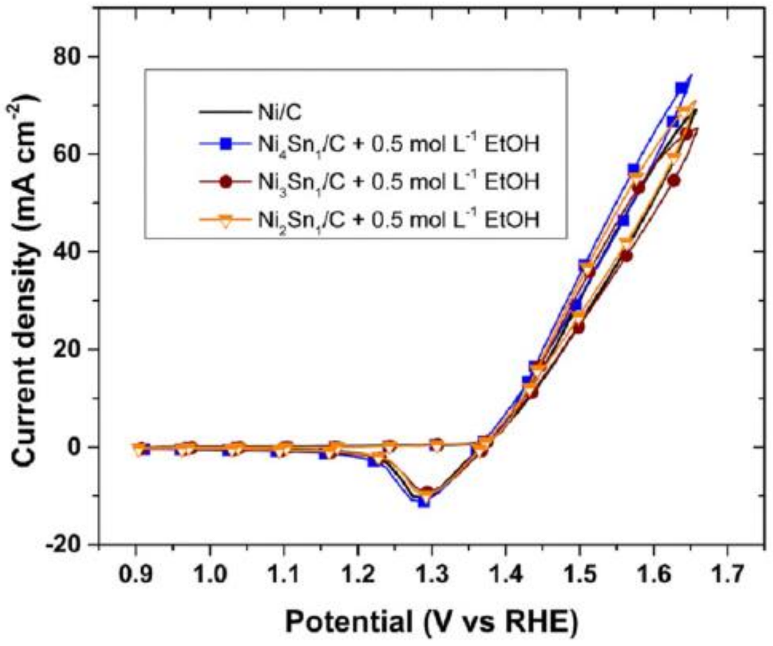


Figure 5: Cyclic voltammogram of Ni/C and NiSn/C electrode in 0.5 mol L^{-1} NaOH + 0.5 mol L^{-1} ethanol at scan rate of 20 mV s^{-1}.

Green and cost-effective synthesis of NiSn alloys by using intermittent microwave heating process as electrocatalysts for ethanol oxidation in alkaline solution

L. R. Vidales-Gallardo[1], Eddie N. Armendáriz-Mireles[1], G. G. Suarez-Velázquez[1], E. Rocha-Rangel[1], W. J. Pech-Rodríguez[1,a)]

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4. Results and discussions

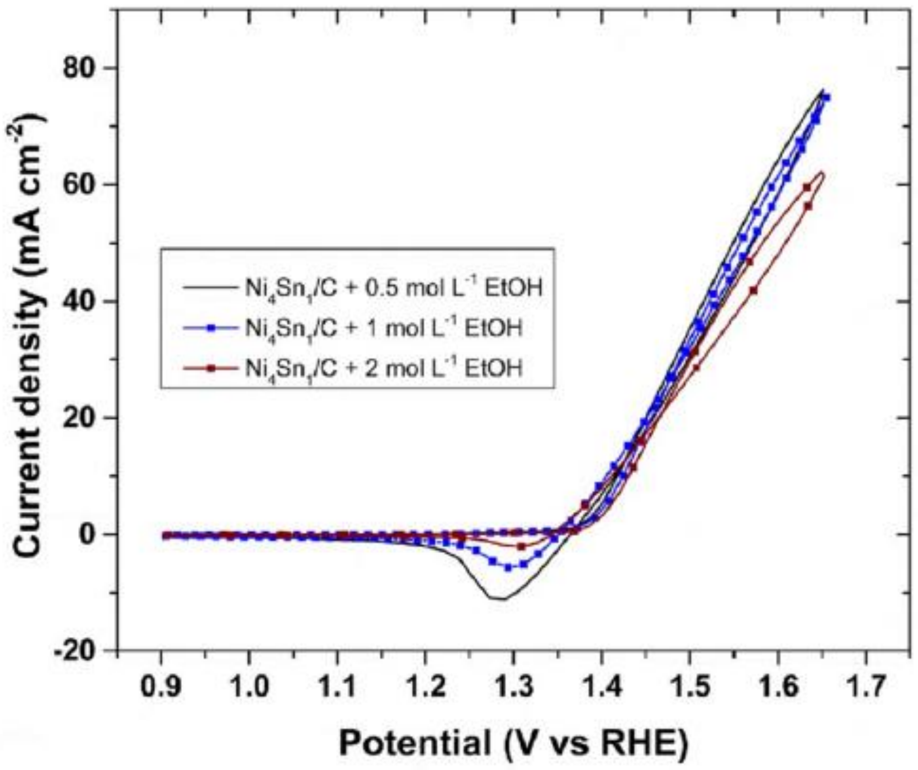

Figure 6: Cyclic voltammogram of modified Ni_4Sn_1/C electrodes at different EtOH concentration.

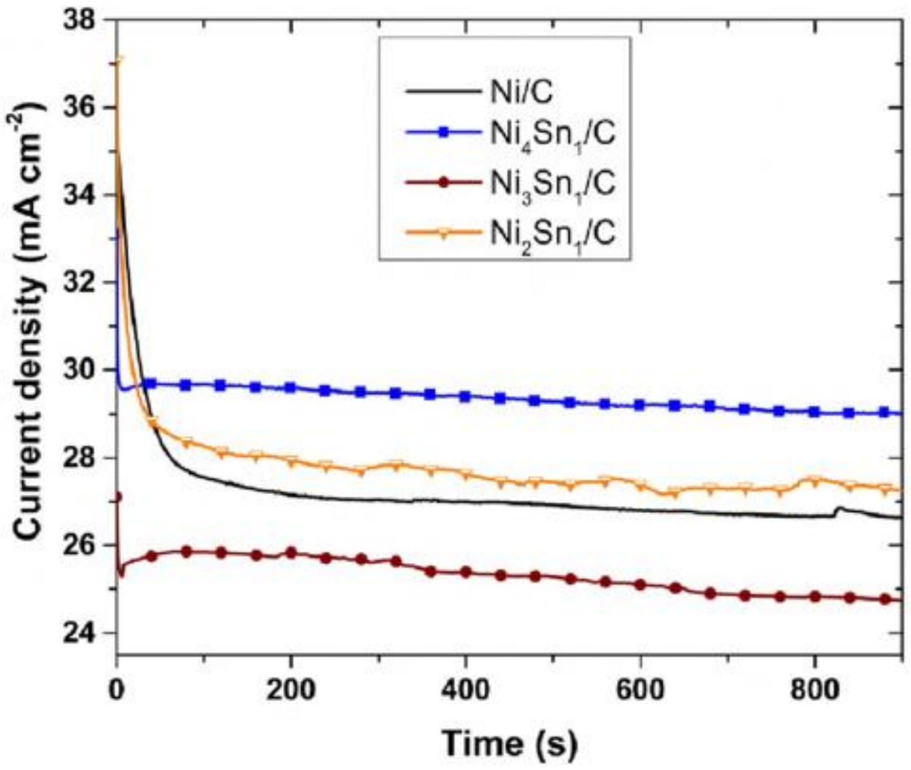

Figure 7: Chronoamperometry curve fot the as-synthesized electrocatalysts in 0.5 mol L^{-1} NaOH + 0.5 mol L^{-1} EtOH at 1.5 V vs RHE.

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5. Conclusion

It is possible to synthesize cheap nanocatalysts with activity for the EOR but improvements in the start potentials need to be achieved for practical applications.

A lot of works may be done to find non-preciuos metal with electrochemical activity than can booster the development of batteries, fuel cell, and solar cell.

Acknowledgements

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References

[1] Pech-Rodríguez WJ, González-Quijano D, Vargas-Gutiérrez G, Rodríguez-Varela FJ. Electrophoretic deposition of polypyrrole/Vulcan XC-72 corrosion protection coatings on SS-304 bipolar plates by asymmetric alternating current for PEM fuel cells. Int J Hydrogen Energy. 2014;39:16740-9.

[2] Velisala V, Pullagura G, Yarramsetty N, Vadapalli S, Boni MK, Gorantla KK. Three-Dimensional CFD Modeling of Serpentine Flow Field Configurations for PEM Fuel Cell Performance. ARABIAN JOURNAL FOR SCIENCE AND ENGINEERING. 2021;46:11687-700.

[3] Velisala V, Srinivasulu GN. Computational fluid dynamics study of 3-pass serpentine flow field configuration on proton exchange membrane fuel cell performance. INTERNATIONAL JOURNAL OF AMBIENT ENERGY. 2020;41:183-8.

[4] Hazar H, Yilmaz M, Sevinc H. The effects of different flow field patterns on polymer electrolyte membrane fuel cell performance. Energy Convers Manage. 2021;248.

[5] Chen X, Chen Y, Liu Q, Xu J, Liu Q, Li W, et al. Performance study on a stepped flow field design for bipolar plate in PEMFC. Energy Reports. 2021;7:336-47.

[6] Peng YM, Yan XH, Lin C, Shen SY, Yin JW, Zhang JL. Effects of flow field on thermal management in proton exchange membrane fuel cell stacks: A numerical study. INTERNATIONAL JOURNAL OF ENERGY RESEARCH. 2021;45:7617-30.

[7] Lim K, Vaz N, Lee J, Ju H. Advantages and disadvantages of various cathode flow field designs for a polymer electrolyte membrane fuel cell. Int J Heat Mass Transfer. 2020;163.

[8] Pan MZ, Li C, Liao JY, Lei H, Pan CJ, Meng XP, et al. Design and modeling of PEM fuel cell based on different flow fields. ENERGY. 2020;207.

[9] Abdulla S, Seepana MM, Patnaikuni VS. Performance Comparison of PEM Fuel Cell with Enhanced Cross-Flow Split Serpentine and Single Serpentine Flow Field Designs. ARABIAN JOURNAL FOR SCIENCE AND ENGINEERING. 2020;45:7691-703.

[10] Marappan M, Palaniswamy K, Velumani T, Chul KB, Velayutham R, Shivakumar P, et al. Performance Studies of Proton Exchange Membrane Fuel Cells with Different Flow Field Designs - Review. CHEMICAL RECORD. 2021;21:663-714.

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