

# Synthesis of Pt-based anodic electrocatalysts for direct ethanol fuel cell applications

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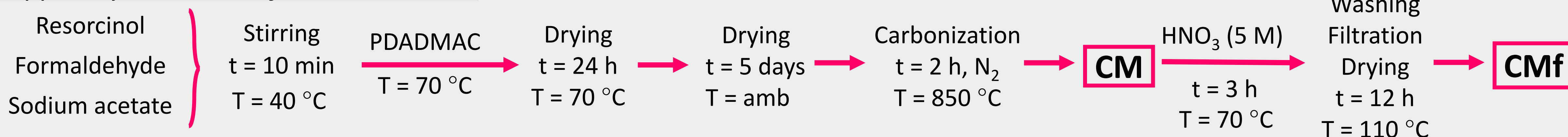
## Introduction

In order to optimize the operation of the direct ethanol fuel cell (DEFC), different materials have been investigated to be used as support for the catalysts in the electrodes of the cells. The most used are carbon-based, within this group of materials, mesoporous carbon has multiple advantages.

This work studies the influence of the functionalization treatment of the mesoporous carbon and the promotion effect of Re on the ethanol electrooxidation reaction (EOR).

## Experimental

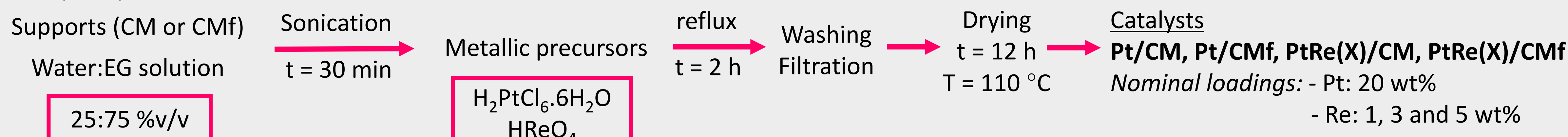
### Support synthesis and functionalization



### Characterization methods

- Nitrogen adsorption-desorption isotherms
- H<sub>2</sub> chemisorption
- X-ray diffraction
- Cyclic voltammetry
- CO stripping
- Chronoamperometry

### Catalyst Synthesis



## Results and Discussion

### N<sub>2</sub> ISOTHERMS

✓ S<sub>BET</sub> CMf < S<sub>BET</sub> CM → destruction or diminution of micropore walls

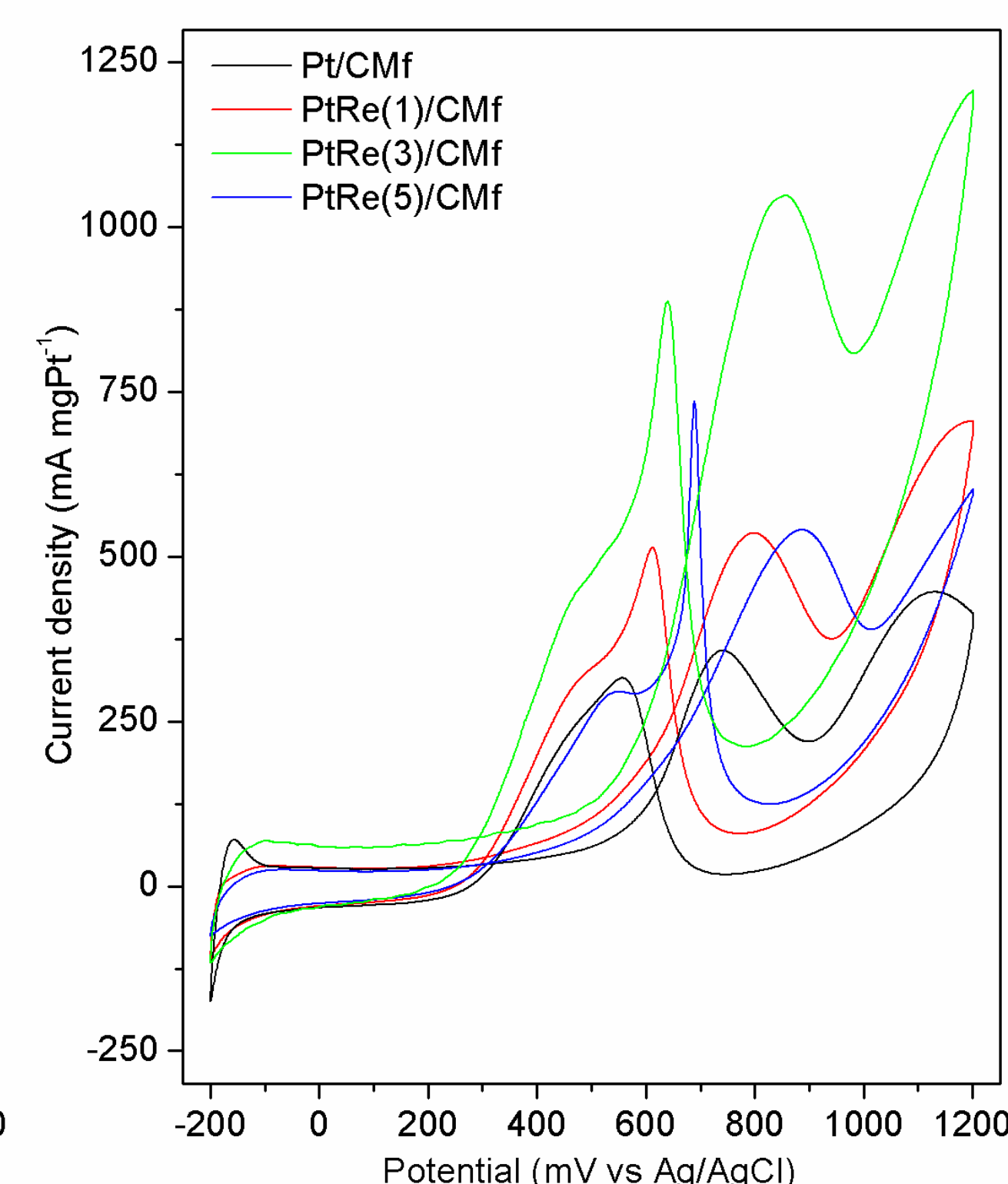
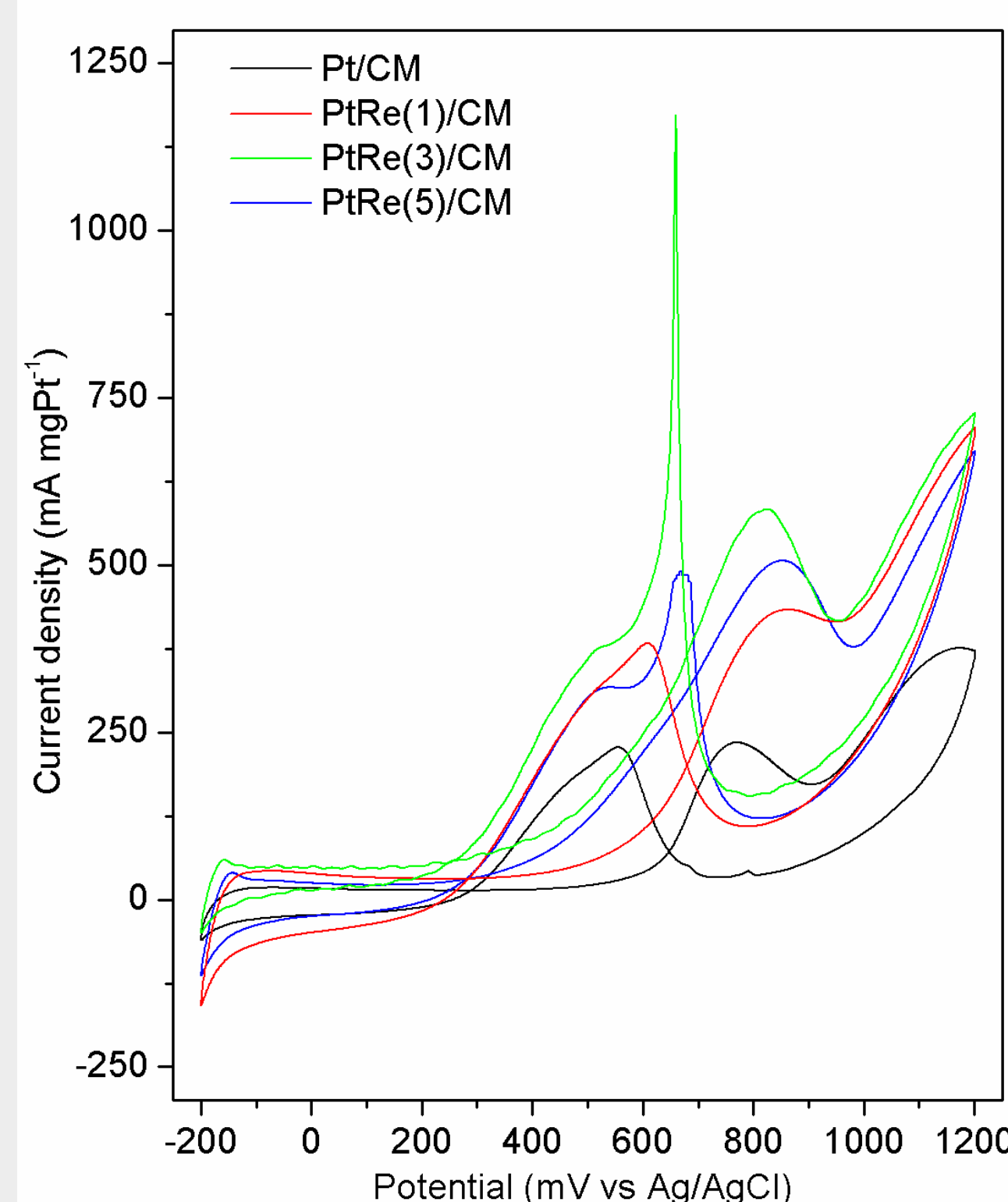
### CYCLIC VOLTAMMETRY

- ✓ Catalysts on CMf, ↑ forward peak current values (most formulations)
- ✓ At higher or lower Re loadings, ↓ catalytic activity
- ✓ Best performance for EOR: **PtRe(3)/CMf** - Peak potential = 856 mV (vs Ag/AgCl)  
- Forward peak current = 1048 mA mgPt<sup>-1</sup>

### X-RAY DIFFRACTION

✓ PtRe lattice parameter ≠ Pt lattice parameter → part of the Re penetrates and modifies the Pt crystal lattice

Catalyst	Chemisorption capacity (H) [μmol gcat <sup>-1</sup> ]	Lattice parameter [nm]	ECSA [m <sup>2</sup> gPt <sup>-1</sup> ]	E <sub>CO,ONSET</sub> [mV vs Ag/AgCl]	Peak potential [mV vs Ag/AgCl]	Forward peak current [mA mgPt <sup>-1</sup> ]
Pt/CM	209	0.39189	20	640	770	235
PtRe(1)/CM	49	0.36398	43	376	863	433
PtRe(3)/CM	120	0.35573	83	385	826	583
PtRe(5)/CM	126	0.37274	62	388	853	507
Pt/CMf	278	0.39196	50	455	740	357
PtRe(1)/CMf	86	0.35979	51	412	798	536
PtRe(3)/CMf	104	0.35178	103	439	856	1048
PtRe(5)/CMf	212	0.36830	87	369	887	540



### H<sub>2</sub> CHEMISORPTION

- ✓ H<sub>PtRe</sub> « H<sub>Pt</sub> → strong interactions between both metals with probable alloy formation
- ✓ H<sub>Pt/CM</sub> < H<sub>Pt/CMf</sub> → higher metallic dispersion

### CO STRIPPING

- ✓ Addition of Re: ↓ onset potential (E<sub>CO,ONSET</sub>) and ↑ electrochemical surface area (ECSA)
- ✓ Best performance: **PtRe(3)/CMf** - ECSA = 102.5 m<sup>2</sup> gPt<sup>-1</sup>  
- E<sub>CO,ONSET</sub> = 439 mV vs Ag/AgCl

### CHRONOAMPEROMETRY

- ✓ Catalysts with Re loading equal to 3 wt% reached the highest current intensity in steady state

## Conclusions

- ✓ Mesoporous carbon was synthesized and functionalized with nitric acid.
- ✓ Mono and bimetallic catalysts with different Re loadings were prepared by the ethylene glycol liquid phase reduction method.
- ✓ Functionalization of the material affects its structure.
- ✓ Presence of a Pt-Re alloy in bimetallic catalysts is observed.
- ✓ PtRe(3)/CMf catalyst exhibits the best electrochemical performance.

