Influence of Interfacial Properties on the Electrocatalytic Behavior of Platinum Electrodes

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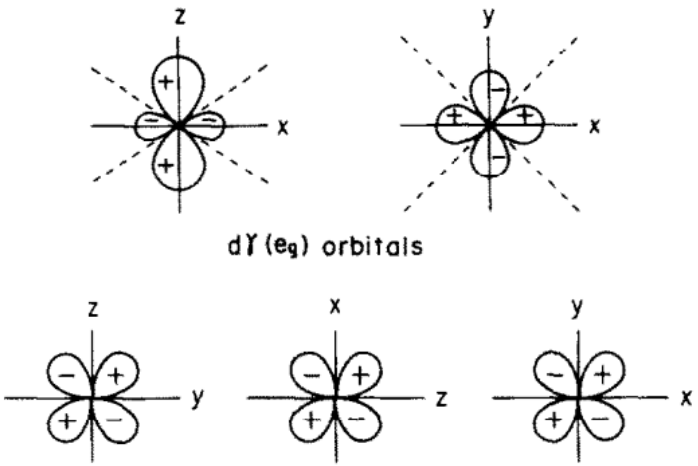
Defensa del plan de investigación
Doctorado en Electroquímica. Ciencia y Tecnología

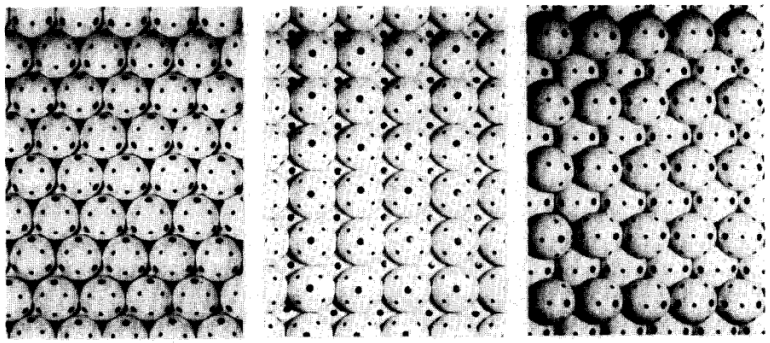
Catalysis is about (right) **Bonds**

18

Surface Science 220 (1989) 18–28
North-Holland, Amsterdam

HYDROGEN ADSORPTION ON PLATINUM SINGLE-CRYSTAL SURFACES





(1 1 1) (1 0 0) (1 1 0)

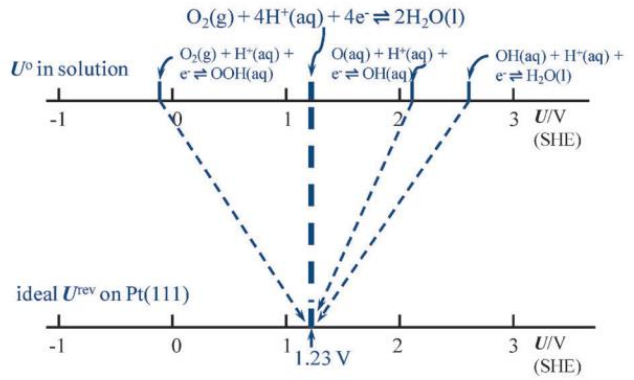
www.rsc.org/pccp

PERSPECTIVE

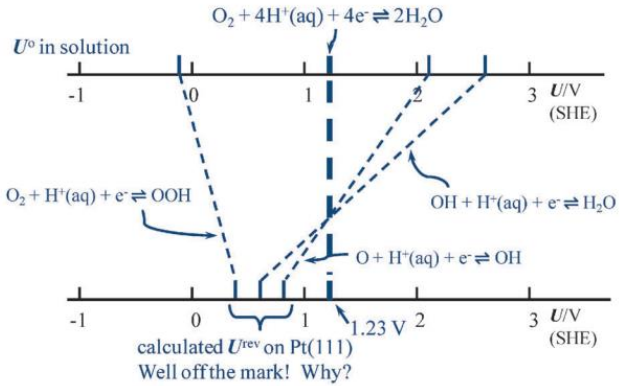
Insights into electrocatalysis

Alfred B. Anderson*

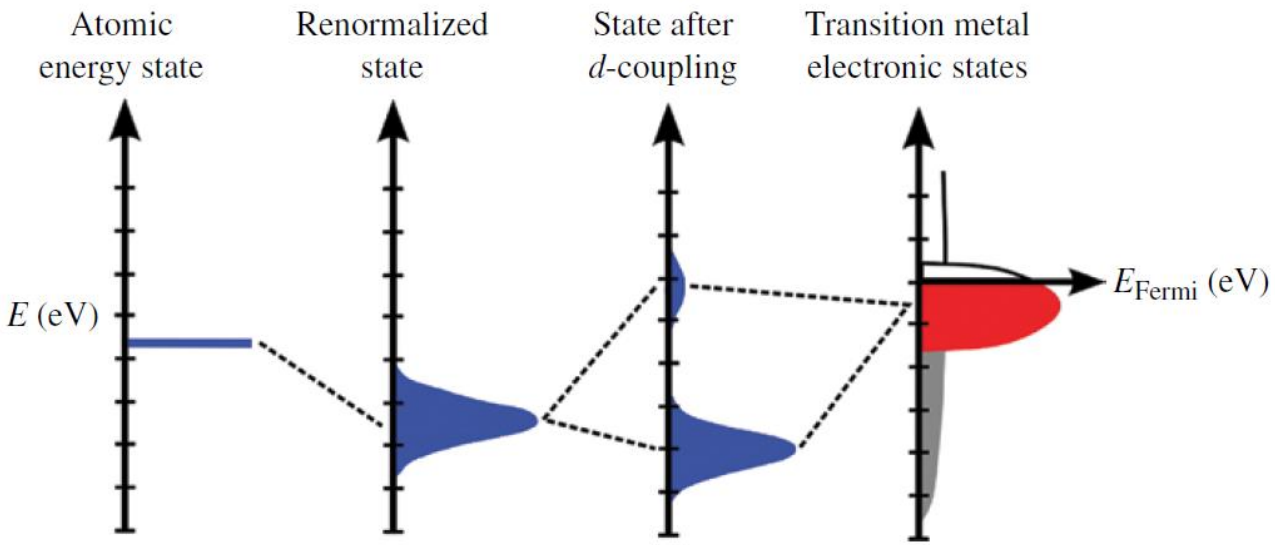
The goal



The reality



Why Platinum is a good catalyst?
d orbitals



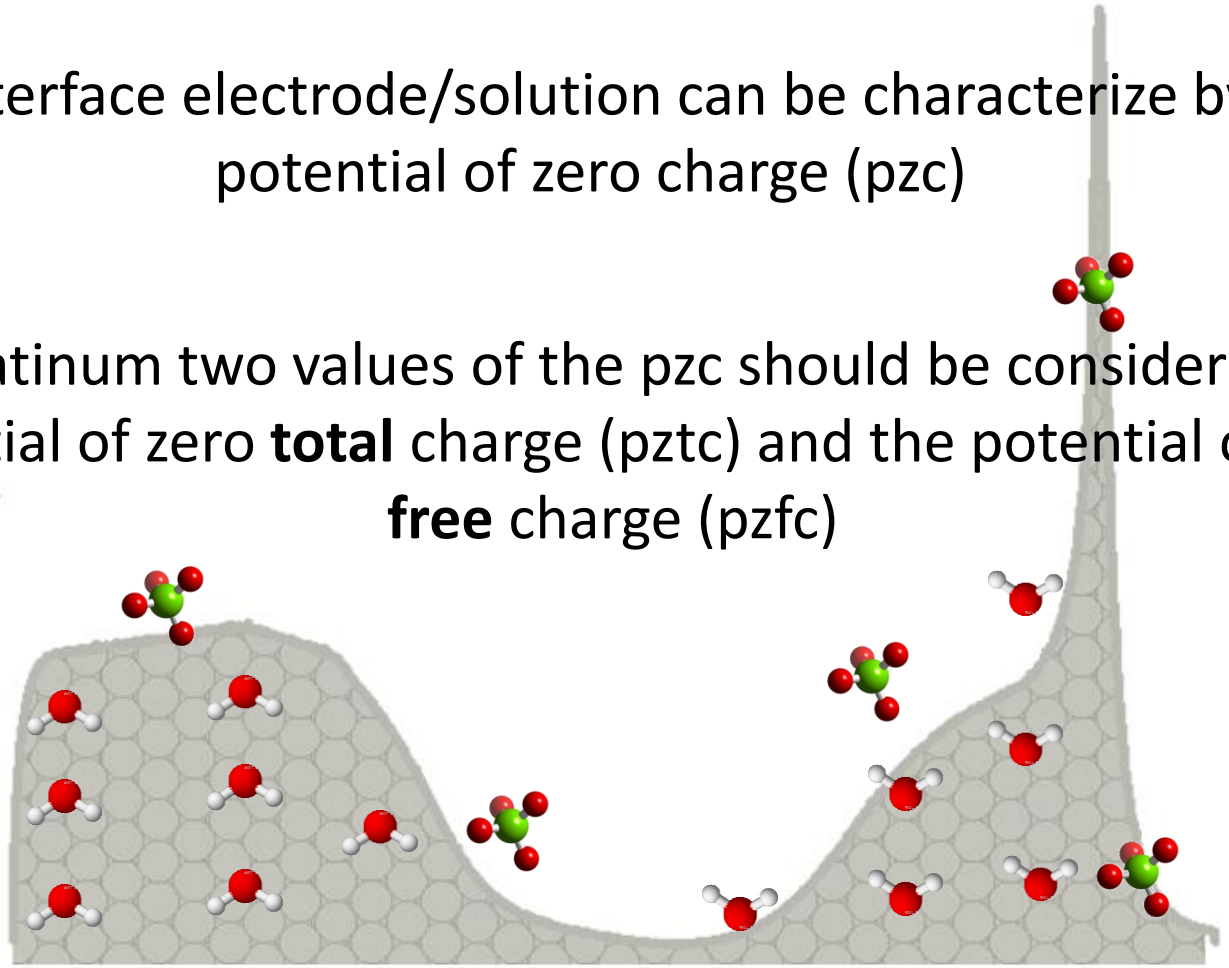
Nickel or **Cobalt** have d orbitals but not are good catalysts (as platinum)

We must consider something more

$$A + nH^+ + ne^- \leftrightarrow B \qquad A + M(H_2O)_n \leftrightarrow M - A + nH_2O$$

The interface electrode/solution can be characterize by the potential of zero charge (pzc)

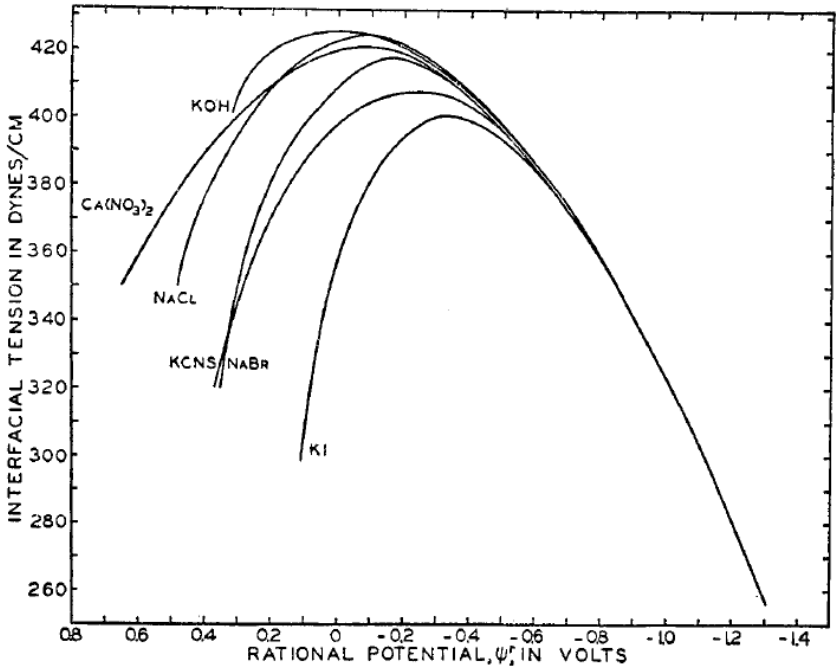
For Platinum two values of the pzc should be considered the potential of zero **total** charge (pztc) and the potential of zero **free** charge (pzfc)



How find the pztc? Electrocapillary curves and Gouy-Chapman minimum

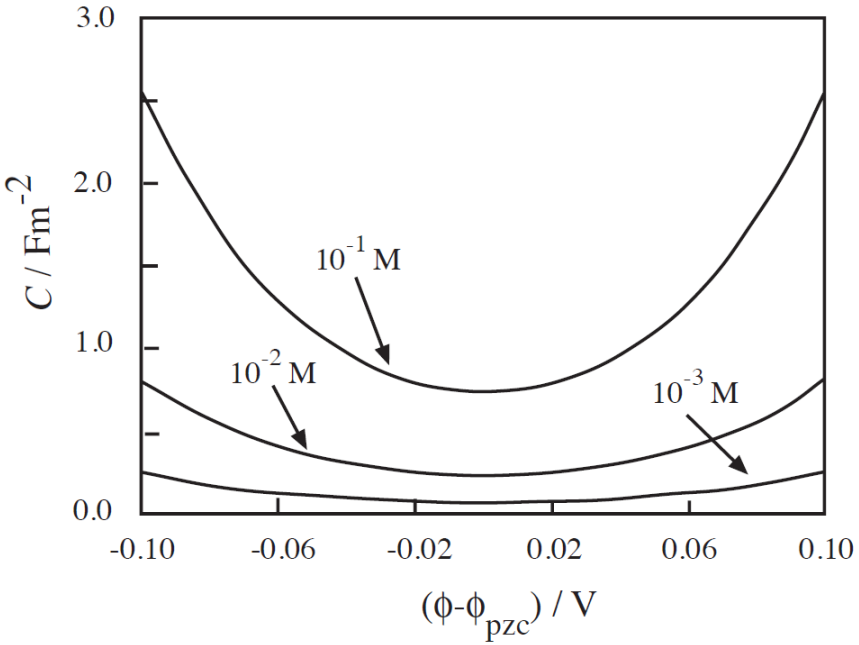
THE ELECTRICAL DOUBLE LAYER AND THE THEORY OF ELECTROCAPILLARITY[1]

DAVID C. GRAHAME



Valid for liquid metals

$$C = \epsilon\epsilon_0\kappa \cosh\left(\frac{ze_0\,(\phi - \phi_{\mathrm{pzc}})}{2kT}\right)$$

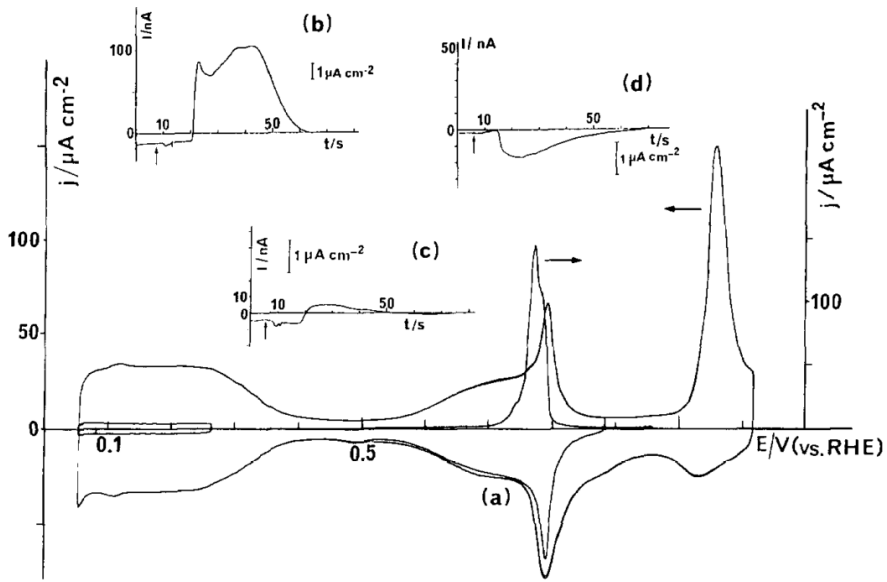


Valid for metals that no adsorbs hydrogen

How find the pztc for metals that adsorb hydrogen? CO displacement

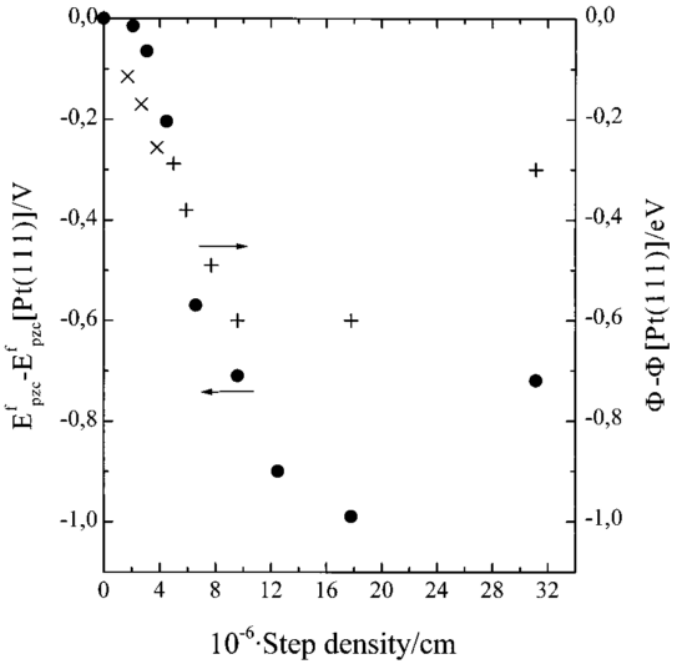
J. Electroanal. Chem., 330 (1992) 489–497
Elsevier Sequoia S.A., Lausanne
JEC 05042

Study of the charge displacement at constant potential during CO adsorption on Pt(110) and Pt(111) electrodes in contact with a perchloric acid solution *



J. Phys. Chem. B **2000,** *104,* 597−605

Dependence of the Potential of Zero Charge of Stepped Platinum (111) Electrodes on the Oriented Step-Edge Density: Electrochemical Implications and Comparison with Work Function Behavior



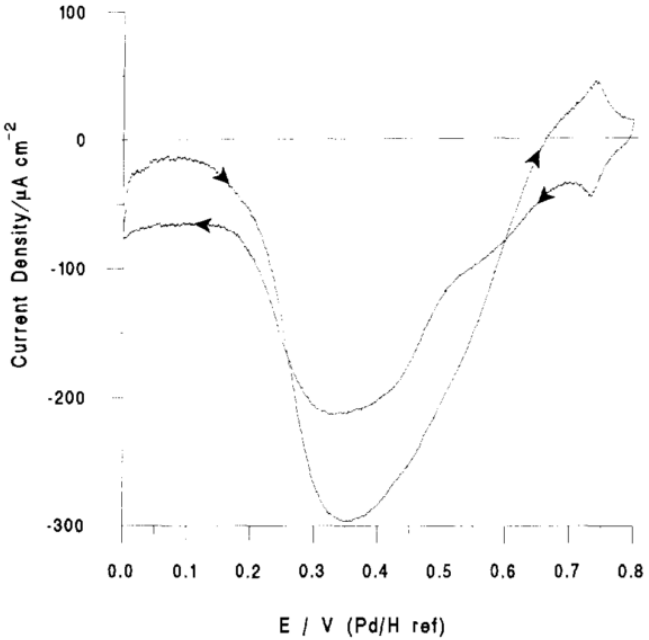
The pzfc and work function are **related**

$$\phi_{pzc} = \frac{1}{e_0}\left(\Phi_M - \Phi_{ref}\right) + \delta_{x_m} - \delta_{x_{sol}}$$

How find the pztc for metals that adsorb hydrogen? Local probes

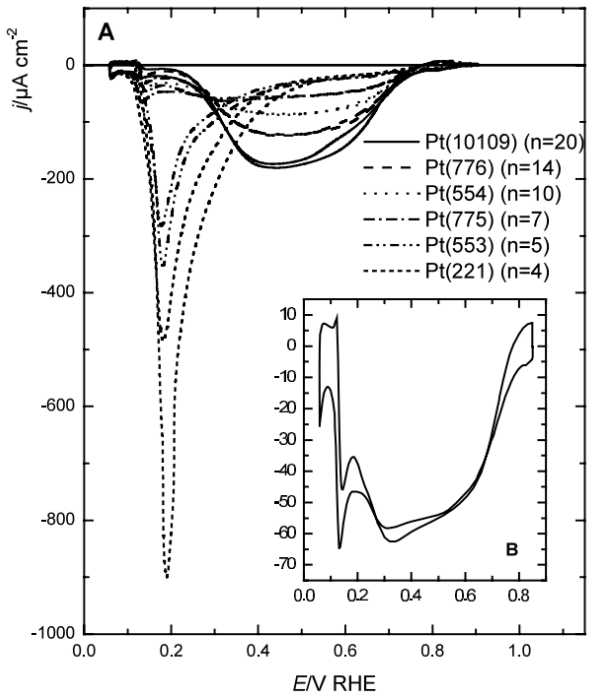
ELSEVIER
Journal of Electroanalytical Chemistry 389 (1995) 175–190

Anion–surface interactions
Part 3. N_2O reduction as a chemical probe of the local potential of zero total charge ☆



ELSEVIER
Journal of Electroanalytical Chemistry 532 (2002) 67–74
Journal of Electroanalytical Chemistry
www.elsevier.com/locate/jelechem

Potential of zero charge of platinum stepped surfaces: a combined approach of CO charge displacement and N_2O reduction



Local probes allows find ¨**local**¨ pztc for stepped surfaces

General

Study the structure of the electrical double layer of the interface platinum/dissolution at different pH conditions and their effect on the surface reactivity of platinum electrodes

Specific

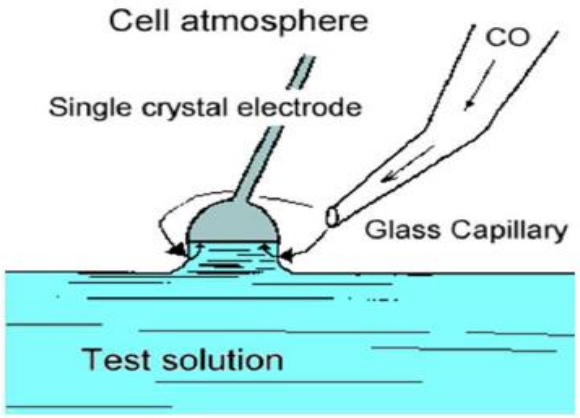
- Electrochemical characterization of kinked single crystal surfaces in different pH conditions

- Determining the potential of zero total charge for platinum single-crystals at different pH conditions using CO displacement

- Analysis of the interface platinum/solution via surface probes at different pH conditions

- Study type reactions in platinum single-crystals at different pH conditions

CO Displacement Method



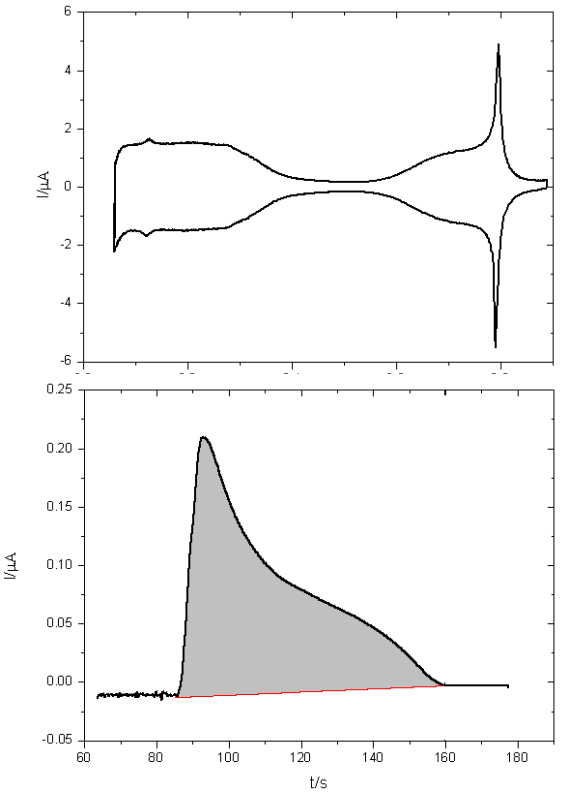
Requirements

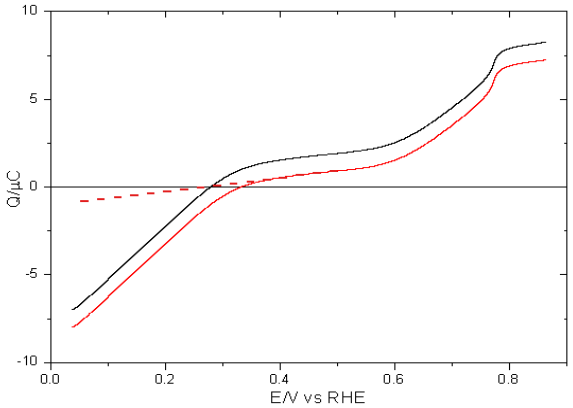
- CO is a neutral probe
- The remaining charge on the electrode/CO interface is small (unnecessary for Pt(111))

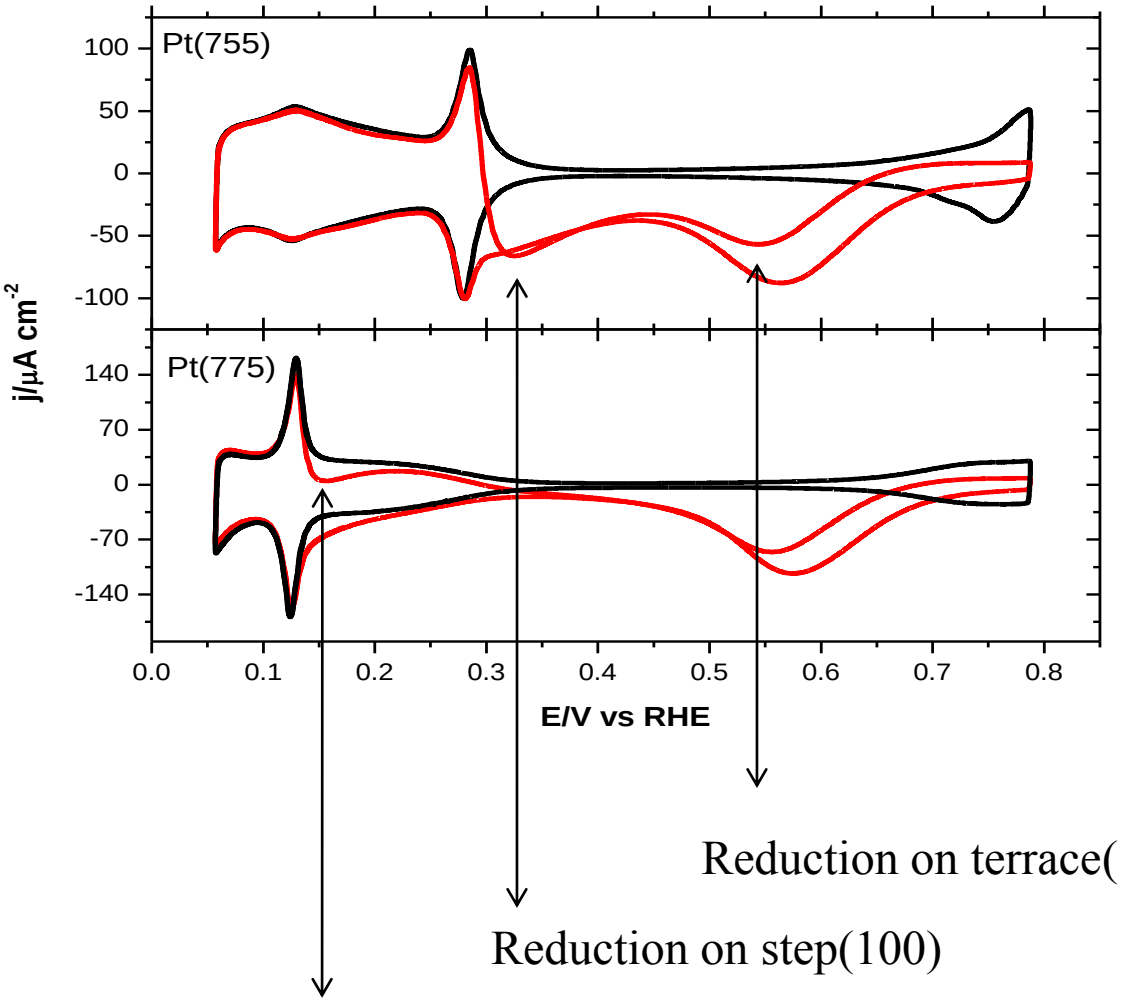
$$q_{dis} = q_{CO} - q(E)$$

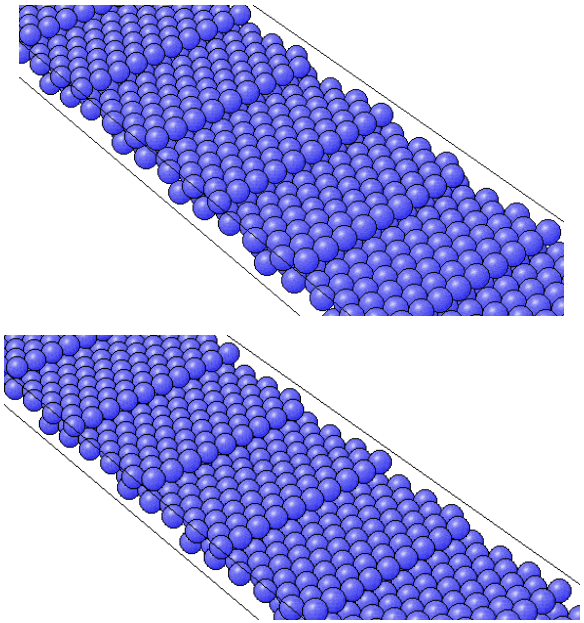
$$q_{co} = \int_{pzc}^{E} C_{co}\, dE$$

$$q(E) = q(E^*) + \int_{E^*}^{E} \frac{j}{v}\, dE$$







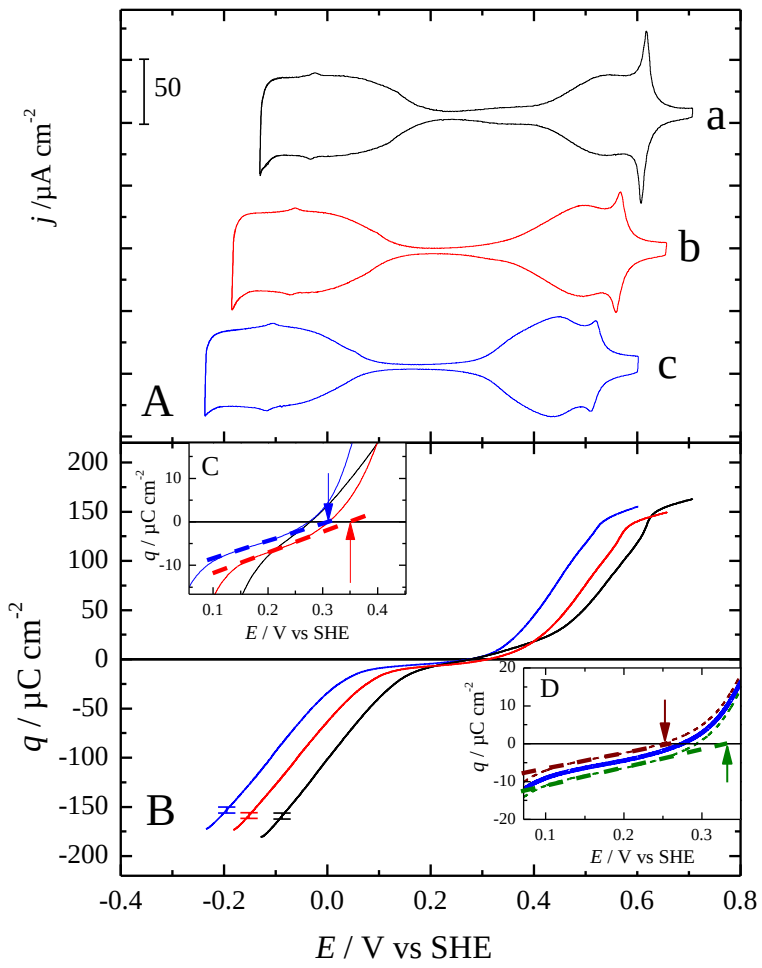


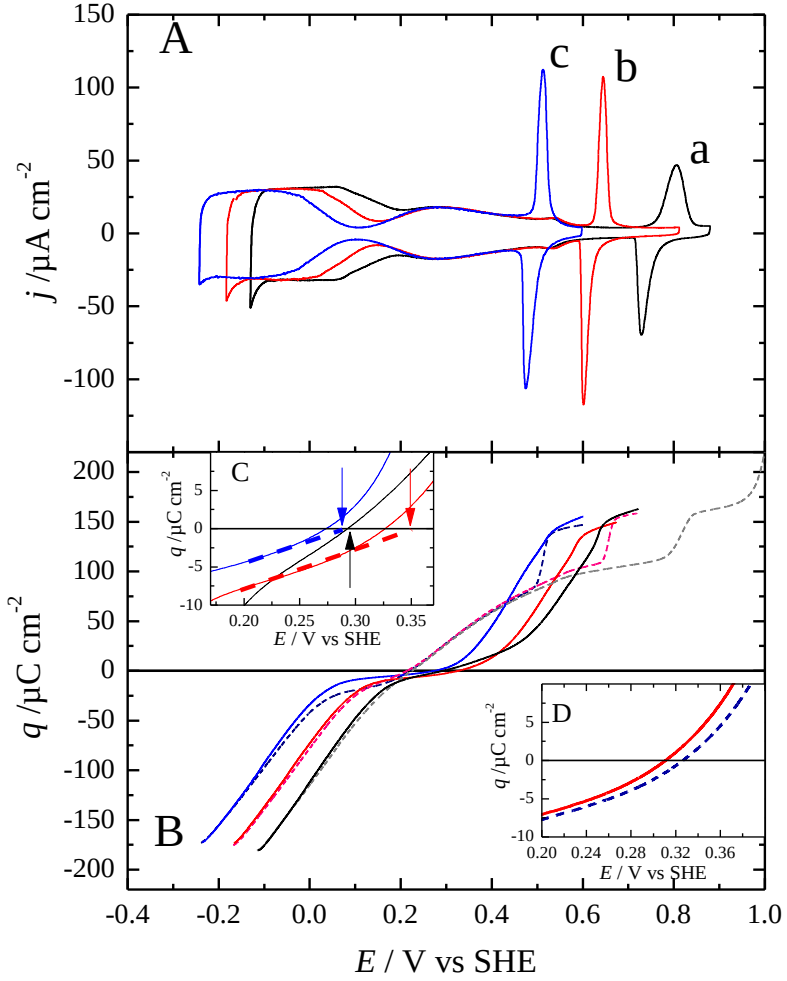
Reduction on terrace(100(6 átomos)

Reduction on step(100)

Reduction on step(100(110)

Año	**1**			**2**			**3**		
Cuatrimestre	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**
Revisión bibliográfica	x	x	x	x	x	x	x	x	x
Caracterización electroquímica de electrodos monocristalinos de platino	x	x							
Determinación del potencial de carga cero por medio de la técnica del desplazamiento por CO			x	x	x				
Determinación del potencial de carga cero por medio del uso de sondas superficiales						x	x		
Estudio de la reacciones de ORR, HER y HOR en diferentes condiciones de pH			x	x	x	x	x		
Redacción de artículos	x	x	x	x	x	x	x	x	x
Redacción tesis								x	x





The neutral point for Pt(111)/solution is around pH 3

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Muchas gracias

acknowledgment

GENERALITAT VALENCIANA
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