

Supplementary information for

**Rapid Assessment of Platinum Disk Ultramicroelectrodes Sealing Quality by
Cyclic Voltammetry Approach**

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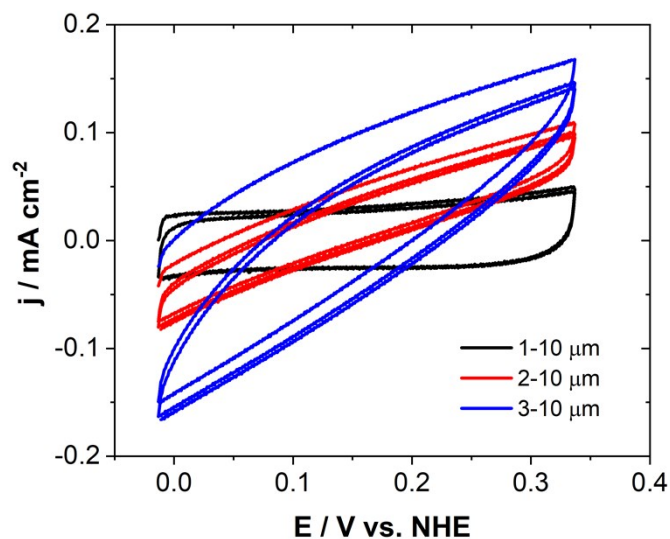


Figure S1. Full length CVs of 10 μm diameter Pt disk UMEs in 0.1 M phosphate buffer (pH = 7).

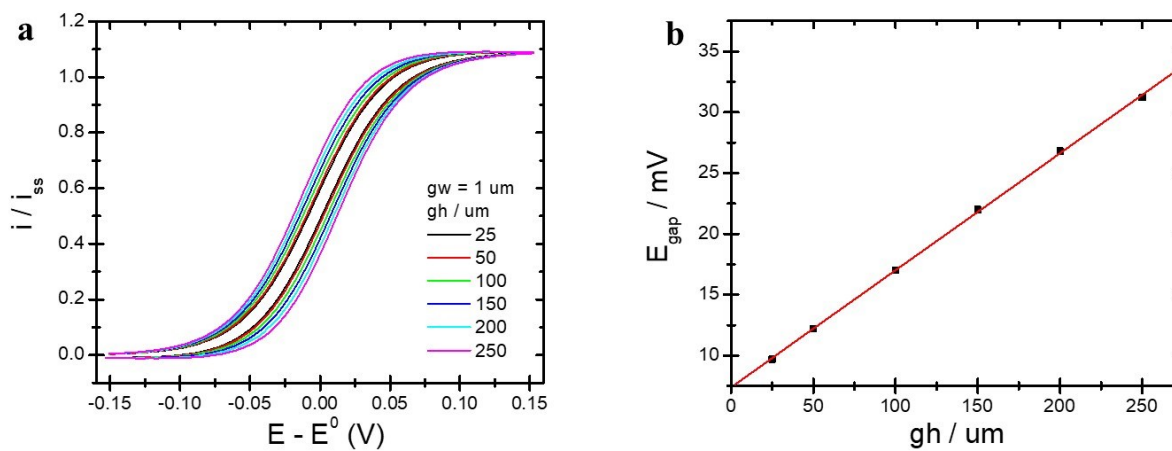


Figure S2. (a) COMSOL simulated CVs for varying gap height as indicated in the inset. (b) Effect of hysteresis observed by varying gap height, data taken from figure (a). Parameters used are; $a = 5 \mu\text{m}$, $D = 7.5 \times 10^{-6} \text{ cm}^2/\text{s}$, $v = 0.025 \text{ V/s}$.

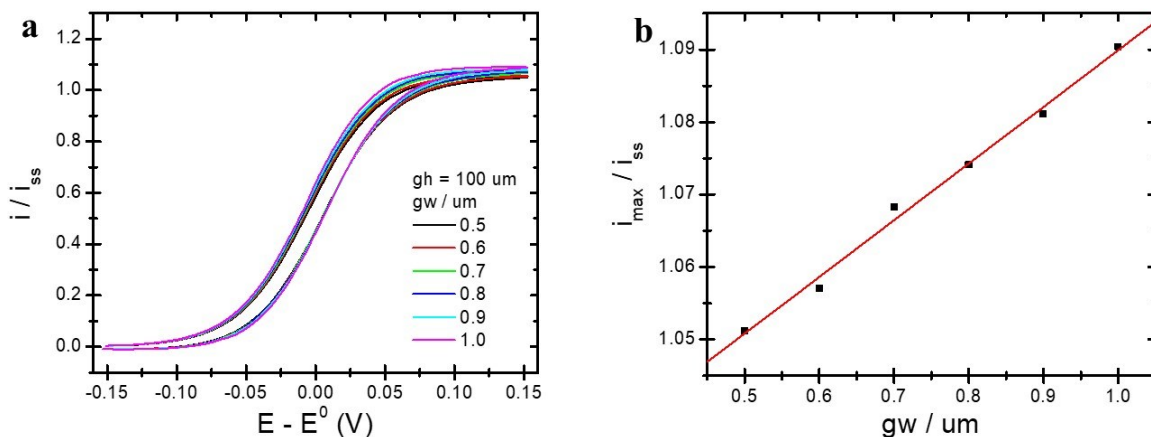


Figure S3. (a) COMSOL simulated CVs for varying gap width as indicated in the inset. (b) Effect of steady state currents observed by varying gap width, data taken from figure (a). Parameters used are; $a = 5 \mu\text{m}$, $D = 7.5 \times 10^{-6} \text{ cm}^2/\text{s}$, $v = 0.025 \text{ V/s}$.

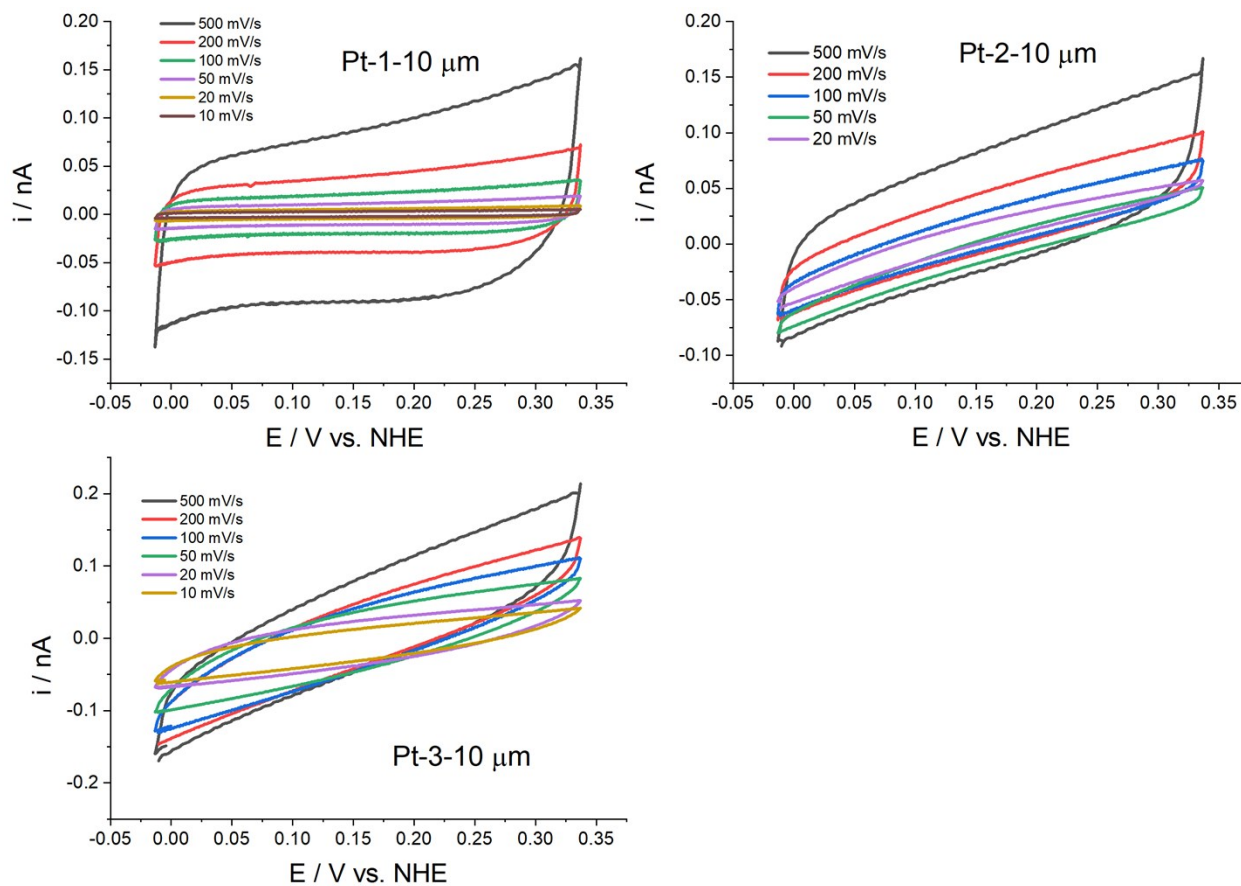


Figure S4. Variation of scan rates for $10 \mu\text{m}$ Pt disk UMEs in 0.1 M phosphate buffer ($\text{pH} = 7$).

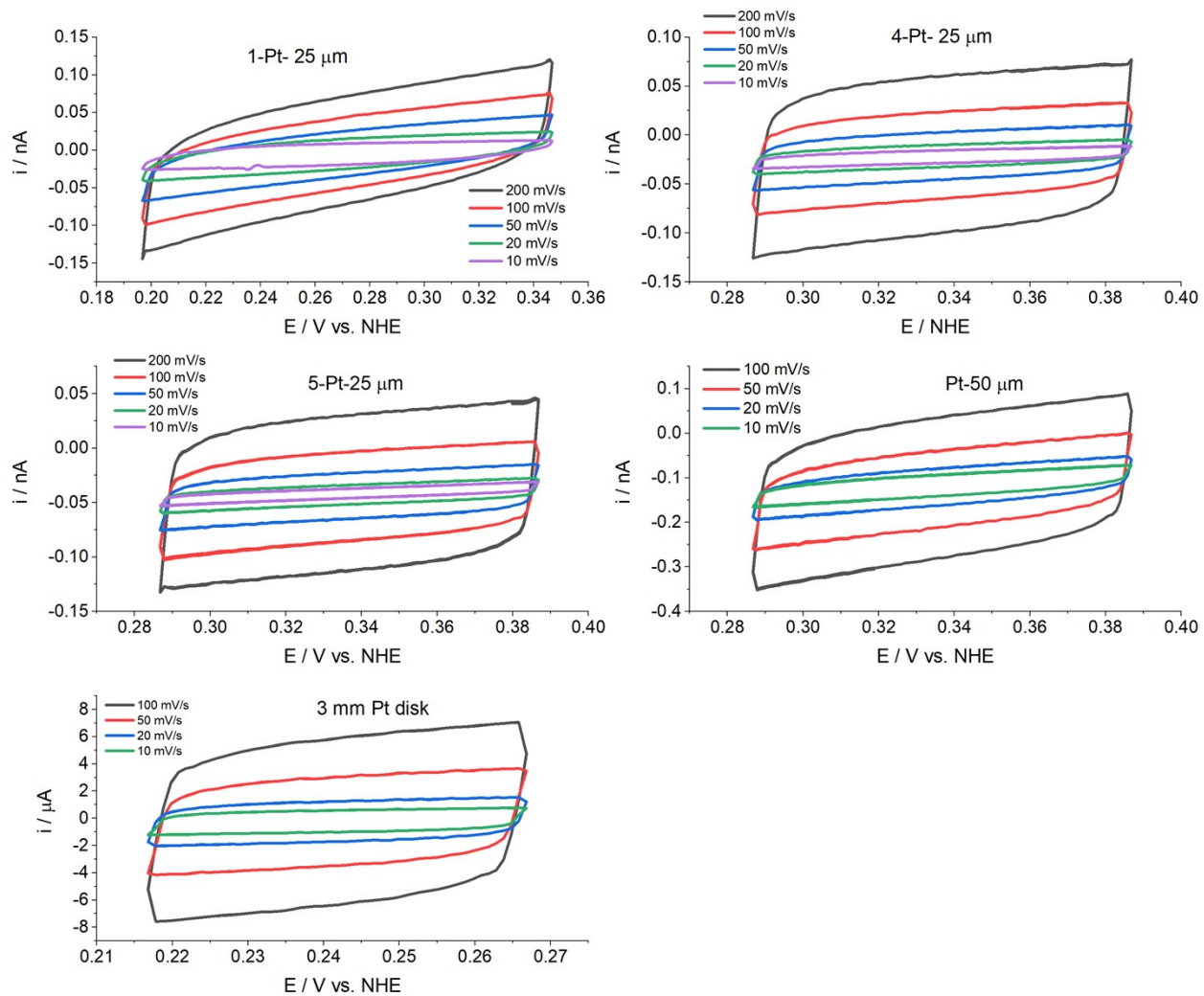


Figure S5. Variation of scan rates for 25 μm , 50 μm and 3 mm Pt disk electrodes in 0.1 M KClO_4 + 0.1 mM HClO_4 .

Report date

Jun 7, 2020 12:19:54 PM

USED PRODUCTS

COMSOL Multiphysics

1.1 PARAMETERS 1

PARAMETERS

Name	Expression	Value	Description
RG	20	20	
gw	0.2	0.2	
gh	20	20	
xi	1	1	
ei	-6	-6	
ef	6	6	
v	0.0324	0.0324	
tf	$2*\text{abs}(ei - ef)/v$	740.74	
df	$6*\text{sqrt}(tf)$	163.3	

2 Component 1

2.1 DEFINITIONS

2.1.1 Functions

Triangle

Function name	tri
Function type	Triangle

Triangle

Potential

Function name	eps
Function type	Analytic

Potential

Psi

Function name	psi
Function type	Analytic

Psi

2.1.2 Probes

Global Variable Probe 2

Probe type	Global variable probe
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Current Probe

Probe type	Global variable probe
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2.1.3 Component Couplings

Integration 1

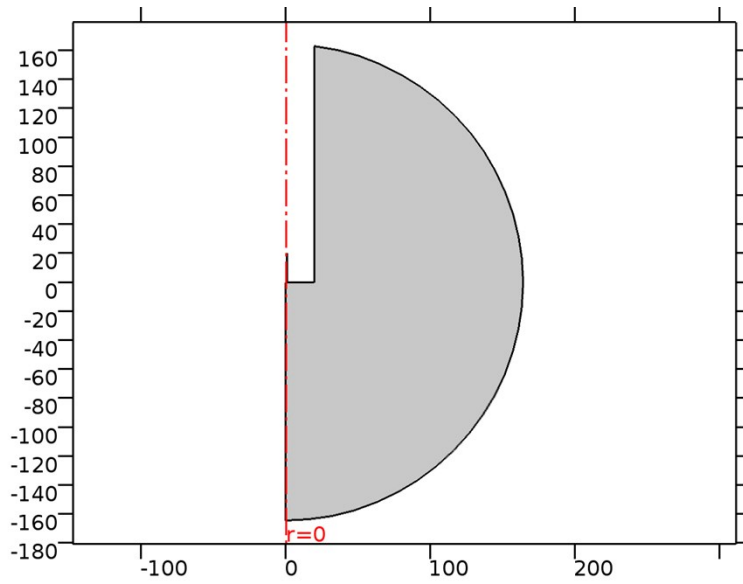
Coupling type	Integration
Operator name	elecInt

2.1.4 Coordinate Systems

Boundary System 1

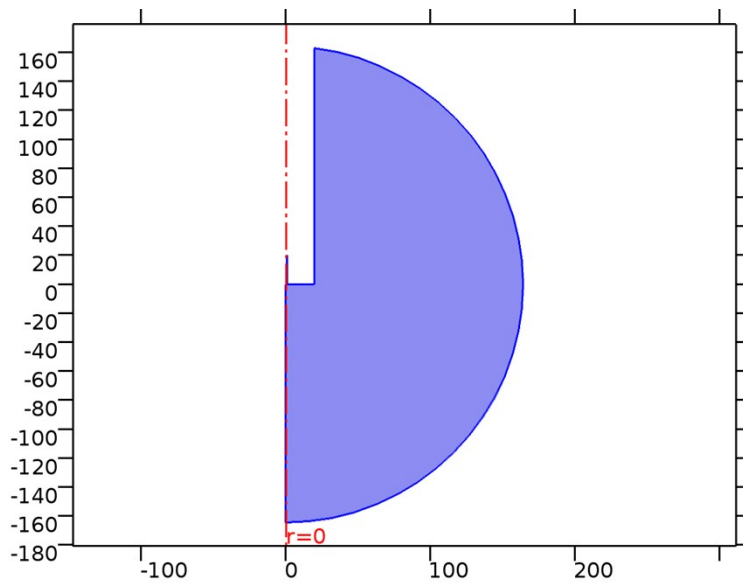
Coordinate system type	Boundary system
Tag	sys1

2.2 GEOMETRY 1



Geometry 1

2.3 COEFFICIENT FORM PDE



Coefficient Form PDE

FEATURES

Diffusion Eq.
Glass
Initial Values
Electrode Surface
Bulk

2.3.1 Diffusion Eq.

EQUATIONS

$$e_a \frac{\partial^2 \mathbf{u}}{\partial t^2} + d_a \frac{\partial \mathbf{u}}{\partial t} + \nabla \cdot (-c \nabla \mathbf{u} - \alpha \mathbf{u} + \gamma) + \beta \cdot \nabla \mathbf{u} + a \mathbf{u} = f$$

$$\mathbf{u} = [cO, cR]^T$$

$$\nabla = \left[\frac{\partial}{\partial r}, \frac{\partial}{\partial z} \right]$$

2.3.2 Glass

EQUATIONS

$$-n \cdot (-c \nabla \mathbf{u} - \alpha \mathbf{u} + \gamma) = 0$$

$$\mathbf{u} = [cO, cR]^T$$

$$\nabla = \left[\frac{\partial}{\partial r}, \frac{\partial}{\partial z} \right]$$

2.3.3 Electrode Surface

EQUATIONS

$$\mathbf{u} = r$$

$$\mathbf{u} = [cO, cR]^T$$

$$g_{\text{reaction}} = -\mu$$

$$\mu = [\mu_1, \mu_2]^T$$

2.3.4 Bulk

EQUATIONS

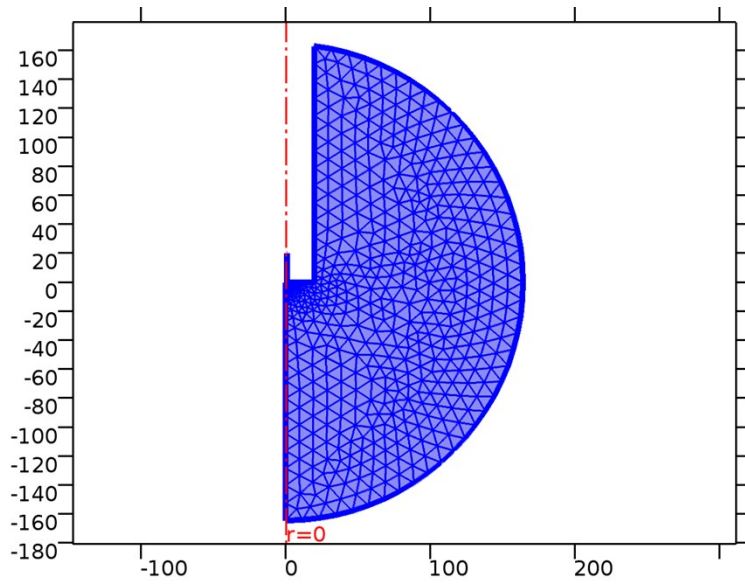
$$\mathbf{u} = r$$

$$\mathbf{u} = [cO, cR]^T$$

$$g_{\text{reaction}} = -\mu$$

$$\mu = [\mu_1, \mu_2]^T$$

2.4 MESH 1



Mesh 1

3 Study 1

COMPUTATION INFORMATION

Computation time	2 min 34 s
CPU	Intel(R) Core(TM) i5-4590S CPU @ 3.00GHz, 4 cores
Operating system	Windows 10

3.1 PARAMETRIC SWEEP

Parameter name	Parameter value list
gh	20
gw	0.1 0.12 0.14 0.16 0.18 0.2

STUDY SETTINGS

Description	Value
Sweep type	All combinations
Parameter name	{gh, gw}
Parameter value list	{20, 0.1 0.12 0.14 0.16 0.18 0.2}
Unit	{, }

3.2 TIME DEPENDENT

Times
range(0,4,tf)

STUDY SETTINGS

Description	Value
Include geometric nonlinearity	Off

PHYSICS AND VARIABLES SELECTION

Physics interface	Discretization
Coefficient Form PDE (c)	physics

MESH SELECTION

Geometry	Mesh
Geometry 1 (geom1)	mesh1