



Novel CeO₂-based Screen-Printed Potentiometric Electrodes for pH monitoring

Stéphanie Betelu, K. Polychronopoulou, C. Rebholz, Ioannis Ignatiadis

► To cite this version:

Stéphanie Betelu, K. Polychronopoulou, C. Rebholz, Ioannis Ignatiadis. Novel CeO₂-based Screen-Printed Potentiometric Electrodes for pH monitoring. *Talanta*, 2011, 87, pp.126-135. 10.1016/j.talanta.2011.09.051 . hal-00665325

HAL Id: hal-00665325

<https://brgm.hal.science/hal-00665325>

Submitted on 10 Feb 2012

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

Tables

Table 1: Preparation of 1L of NH_4Cl / NH_3 and NaHCO_3 / Na_2CO_3 buffer solutions.

Table 2: SPEs capacitive current obtained in NaCl 0.1 mol L^{-1} . Experimental conditions: CV between 0.1V/NHE and 1V/NHE . Scan rate: 0.05 V s^{-1} , 5 electrodes.

Table 3: $|\Delta E|$ (mV) as well as anodic and cathodic i_p (nA) measured by CV in NaCl 0.1 mol L^{-1} containing $\text{FcTMA}^+ 2 \cdot 10^{-3} \text{ mol L}^{-1}$. Experimental conditions: CV between 0.1V/NHE and 1V/NHE . Scan rate: 0.05 V s^{-1} , 5 electrodes.

Table 4: Results of the simulation of EIS measurements

Table 1

NH₄Cl/NH₃ buffer solutions					
		Volume (mL) of		Total equivalent activity of	
	pH	HCl (1 mol L ⁻¹)	NH ₃ (1 mol L ⁻¹)	NH ₄ ⁺ (mol L ⁻¹)	NH ₃ (mol L ⁻¹)
	7.2	50.0	50.7	3.4 10 ⁻²	3.0 10 ⁻⁴
	7.5	50.0	51.1	3.4 10 ⁻²	6.3 10 ⁻⁴
	7.6	50.0	50.3	3.4 10 ⁻²	8.0 10 ⁻⁴
	8.6	50.0	60.0	3.4 10 ⁻²	8.0 10 ⁻³
	9.3	50.0	97.0	3.3 10 ⁻²	3.8 10 ⁻²
	9.5	50.0	125.0	3.3 10 ⁻²	5.9 10 ⁻²
	9.7	50.0	170.0	3.2 10 ⁻²	9.2 10 ⁻²
	10.6	50.0	950.0	2.2 10 ⁻²	4.5 10 ⁻¹
	10.8	30.0	970.0	1.4 10 ⁻²	4.7 10 ⁻¹
NaHCO₃/Na₂CO₃ buffer solutions					
		Volume (mL) of		Total equivalent activity of	
IS*	pH	NaHCO ₃ (1 mol L ⁻¹)	Na ₂ CO ₃ (1 mol L ⁻¹)	HCO ₃ ⁻ (mol L ⁻¹)	CO ₃ ²⁻ (mol L ⁻¹)
0.05	8.6	53.0	22.0	3.8 10 ⁻²	1.2 10 ⁻³
	8.9	43.0	3.6	3.1 10 ⁻²	1.8 10 ⁻³
	9.7	21.8	9.4	1.6 10 ⁻²	4.7 10 ⁻³
0.10	9.6	45.3	18.2	3.1 10 ⁻²	8.3 10 ⁻³
	10.1	24.9	22.3	1.8 10 ⁻²	1.0 10 ⁻²
	10.6	7.1	30.8	5.3 10 ⁻³	1.4 10 ⁻²
0.20	9.3	115.7	28.2		
	10.1	36.1	54.6		
	10.4	19.3	60.1		
	10.6	12.3	62.4		
	11.8	3.9	64.9		

*IS: Ionic strength

Table 2

SPEs	I_c (nA)
C	36 ± 1
CeO ₂	40 ± 2
Ce _{0.8} Sm _{0.2} O ₂	260 ± 10
Ce _{0.8} Zr _{0.2} O ₂	470 ± 20

Table 3

SPEs	ΔE (mV)	i_{pa} (nA)	i_{pc} (nA)
C	62 ± 2	195 ± 10	195 ± 10
CeO ₂	63 ± 3	205 ± 10	205 ± 10
Ce _{0.8} Sm _{0.2} O ₂	60 ± 3	205 ± 10	205 ± 10
Ce _{0.8} Zr _{0.2} O ₂	60 ± 3	205 ± 10	205 ± 10

Table 4

SPEs	EE Circuit	Component of the equivalent electrical circuit (EEC)					χ^2
		R_e (ohm)	C_d (μ F)/cm ²	R_t (ohm)	Q-Yo ($\times 10^6$)	Q-n	
CeO ₂	R(C(RQ))	0.0	1.89	1587.0	0.556	0.927	0.0188
CeO ₂	R(CR)Q	0.0	1.89	1583.0	0.556	0.927	0.0187
Ce _{0.8} Sm _{0.2} O ₂	R(C(RQ))	0.0	0.63	5395.0	6.397	0.923	0.0073
Ce _{0.8} Sm _{0.2} O ₂	R(CR)Q	0.0	0.63	5395.0	6.397	0.923	0.0073
Ce _{0.8} Zr _{0.2} O ₂	R(C(RQ))	0.0	0.31	19140.0	3.169	0.944	0.0088
Ce _{0.8} Zr _{0.2} O ₂	R(CR)Q	0.0	0.31	19140.0	3.169	0.944	0.0088
C	R(C(RQ))	0.0	1.20	2316.0	0.487	0.920	0.0101
C	R(CR)Q	0.0	1.20	2313.0	0.488	0.920	0.0101