

Supplementary Materials

Sensitive and Selective Potentiometric Sensor Based on Carbon Paste Electrode for Determining Cerium(III) Ions in Soil and Water Samples; Simplex Lattice Mixture Design Application

Azam Hosseini Fakhrabad¹, Razieh Sanavi khoshnood^{1*}, Mohammad Reza Abedi²,
and Mahmoud Ebrahimi¹

¹ Department of Chemistry, Mashhad Branch, Islamic Azad University, Mashhad, Iran

² Department of Chemistry, Quchan Branch, Islamic Azad University, Quchan, Iran

*Corresponding Author, Tel.: +989151176370

E-Mail: rskhoshnood@yahoo.com

Table S1. ANOVA for optimization of the CPE composite using the simplex lattice mixture design

Source	Sum of Squares	DF ¹	Mean Square	F-value	p-value	Significant
Model	23.39	9	2.60	93.78	< 0.0001	+
Linear	17.01	3	5.67	204.69	< 0.0001	+
Mixture						
AB	0.3970	1	0.3970	14.33	0.0036	+
AC	2.67	1	2.67	96.22	< 0.0001	+
AD	0.1283	1	0.1283	4.63	0.0569	-
BC	0.8114	1	0.8114	29.29	0.0003	+
BD	0.1065	1	0.1065	3.84	0.0783	-
CD	2.39	1	2.39	86.11	< 0.0001	+
Residual	0.2771	10	0.0277			
Lack of Fit	0.0858	5	0.0172	0.4488	0.8001	-
Pure Error	0.1913	5	0.0383			
Cor Total	23.66	19				

¹ Degree of Freedom

Table S2. The Statistic data for a fitted equation.

Standard Deviation	0.1665	R²	0.9883
Mean	19.08	Adjusted R²	0.9778
C.V. %	0.8722	Predicted R²	0.8978
		Adeq Precision	33.5293

Table S3. The Optimization value of the components in CPE

Component	Name	Level	Low Level	High Level	Std. Dev.	Coding
A	Graphite powder	0.5405	0.5000	0.6000	0.0000	Actual
B	BPDA	0.1409	0.1000	0.2000	0.0000	Actual
C	MWCNT-COOH	0.1186	0.1000	0.2000	0.0000	Actual
D	[HIMIM][PF ₆]	0.2000	0.2000	0.3000	0.0000	Actual
Total =		1.00				

Table S4. The lifetime of the sensor for the Ce (III) ion determination

Week	0	2	4	6	8	10
Slope(mVdecade⁻¹)	19.77	19.2	18.5	18.2	15.7	15.4
R²	0.99	0.99	0.98	0.97	0.97	0.97

Table S5. Selectivity coefficients of various interfering ions for the Ce (III) ion determination using the sensor

Interfering ion	K_{MPM}	Interfering ion	K_{MPM}
Mn(II)	2.3×10^{-3}	Fe(III)	4.2×10^{-4}
Cu(II)	6.7×10^{-4}	Co(II)	3.1×10^{-4}
Ni(II)	6.4×10^{-5}	Al(III)	7.4×10^{-3}
Cd(II)	7.1×10^{-4}	Mg(II)	6.2×10^{-5}
K(I)	6.3×10^{-3}	Cr(III)	3.6×10^{-6}
La(III)	3.2×10^{-5}	Sm(III)	7.8×10^{-4}
Nd(III)	5.4×10^{-4}	Gd(III)	4.9×10^{-4}

Table S6. Determination of Ce (III) ion concentration in the presence of other metal ions (1.0×10^{-7} M) (n=3)

Added ion	Found ([Ce (III) ion] $\pm$ S) $\times 10^{-7}$ M	Recovery (%)
Sr(II) & K(I) ions	1.43 ± 0.03	95.3
Zn(II) & Cd(II) ions	1.39 ± 0.02	92.7
Ni(II) & Cu(II) ions	1.56 ± 0.04	104.0
Al(III) & Mn(III) ions	1.62 ± 0.02	108.0
Na(I) & Mg(II) ions	1.35 ± 0.06	90.0
Al(III), Mn(III) & Ni (II) ions	1.41 ± 0.04	94.0
Mg (II), K (I) & Al (III) ions	1.35 ± 0.03	90.0
Ni (II), Cu (II) & Zn (II) ions	1.50 ± 0.05	100.0
Cu (II), Ag (I) & Zn (II) ions	1.48 ± 0.02	98.7