







Supplementary material to
Parameter selection of cerium oxide anodic electrodeposition on screen-printed carbon electrodes using response surface methodology for nucleic acid based biosensors

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J. Electrochem. Sci. Eng. **16** (2026) 3077; <http://dx.doi.org/10.5599/jese.3077>

Figure S1 shows the SPCE used in this study. The SPCE consists of a carbon-based working electrode and counter electrode, as well as an Ag/AgCl reference electrode on a single inert substrate.

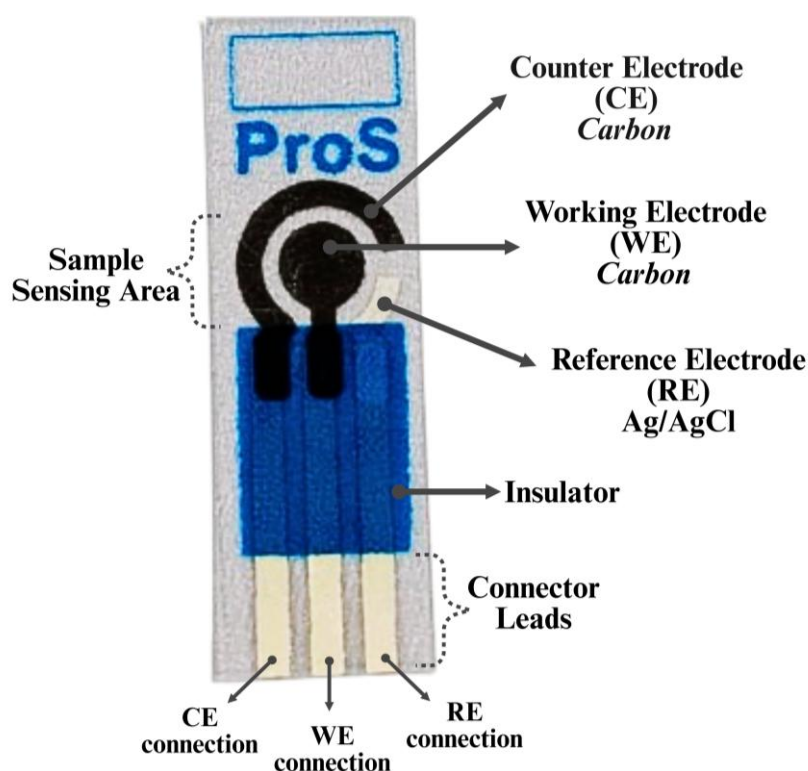


Figure S1. Picture of SPCE ProSENS-C used in this manuscript

Table S1 presents the level combinations of each parameter tested in runs 1 to 16 during the first-stage parameter selection. The number of runs and the corresponding combinations were determined using a 2-level 1/2 fractional factorial design with two replications, calculated using R Jupyter Notebook program.

Table S1. Level combinations and current peak responses in the first stage of parameter selection

Number of run	Pre-treatment of SPCE using UV light	$C_{Ce(NO_3)_3}$ / ppm	Scan rate, $V s^{-1}$	Number of CV cycles	Current peak, μA
1	No	100	0.05	15	11.993
2	Yes	100	0.05	5	23.545
3	Yes	1000	0.05	15	22.043
4	No	1000	0.05	5	13.716
5	No	1000	0.10	15	15.335
6	Yes	1000	0.10	5	19.050
7	No	100	0.10	5	15.211
8	Yes	100	0.10	15	19.722
9	No	100	0.05	15	15.798
10	No	100	0.10	5	19.345
11	Yes	1000	0.05	15	31.960
12	Yes	1000	0.10	5	20.625
13	Yes	100	0.10	15	21.477
14	Yes	100	0.05	5	16.574
15	No	1000	0.10	15	36.873
16	No	1000	0.05	5	34.956

Each level consisted of a total of eight runs, producing eight peak current values (Table S1). All peak current values at each level were summed to calculate the average value using Equation (1):

$$\text{Average peak current} = \frac{\text{Sum of peak current values}}{\text{Numbers of run}} \quad (1)$$

The total and average peak current values for each parameter in the first stage of parameter selection are presented in Table S2.

Table S2. Average peak current values in the first stage of parameter selection (8 runs total)

Parameter	Level	Peak current value total, μA	Average peak current, μA
Pre-treatment of SPCE using UV light	Yes	174.996	21.87
	No	163.227	20.40
Concentration of cerium nitrate solution, ppm	100	143.665	17.96
	1000	194.558	24.33
Scan rate of CV, $V s^{-1}$	0.05	170.585	21.32
	0.10	167.638	20.95
Number of CV cycles	5	163.022	20.38
	15	175.201	21.90

Table S3 presents the level combinations of each parameter tested in runs 1 to 24 during the second stage of parameter selection. The number of runs and the corresponding combinations were determined using a 2-level 1/2 fractional factorial design with three replications, calculated using R Jupyter Notebook program.

Table S3. Level combinations and current peak responses in the second stage of parameter selection

Run number	UV irradiation time, min	Distance of SPCE to UV lamp, cm	$C_{\text{Ce}(\text{NO}_3)_3}$ / ppm	Number of CV cycles	Current peak, μA
1	15	7.2	1000	30	34.526
2	15	1.7	1000	15	25.208
3	60	1.7	1000	30	34.062
4	60	7.2	1000	15	38.922
5	60	7.2	2000	30	27.547
6	60	1.7	2000	15	26.498
7	15	7.2	2000	15	32.486
8	15	1.7	2000	30	10.901
9	15	7.2	1000	30	22.278
10	15	7.2	2000	15	23.401
11	60	1.7	1000	30	38.251
12	60	1.7	2000	15	30.376
13	15	1.7	2000	30	8.121
14	15	1.7	1000	15	25.729
15	60	7.2	2000	30	31.779
16	60	7.2	1000	15	33.582
17	60	1.7	2000	15	25.374
18	15	7.2	2000	15	28.732
19	60	7.2	2000	30	25.649
20	15	7.2	1000	30	23.958
21	60	1.7	1000	30	25.010
22	60	7.2	1000	15	36.140
23	15	1.7	1000	15	31.641
24	15	1.7	2000	30	10.183

Each level consisted of a total of twelve runs, producing twelve peak current values (Table S3). All peak current values at each level were summed to calculate the average value using Equation (1). The total and average peak current values for each parameter in the second stage of parameter selection are presented in Table S4.

Table S4. Average peak current values in the second stage of parameter selection (12 runs total)

Parameter	Level	Peak current value total, μA	Average peak current, μA
UV irradiation time, min	15	277.164	23.09
	60	373.190	31.09
Distance of SPCE to UV lamp, cm	1.7	291.354	24.28
	7.2	359.000	29.92
Concentration of cerium nitrate solution, ppm	1000	369.307	30.77
	2000	281.047	23.42
Number of CV cycle	15	358.089	29.84
	30	292.265	24.35