

Supplementary material to

High-sensitivity electrochemical immunosensor for anti-SARS-CoV-2 IgG detection using screen-printed carbon/cerium oxide-gold electrode

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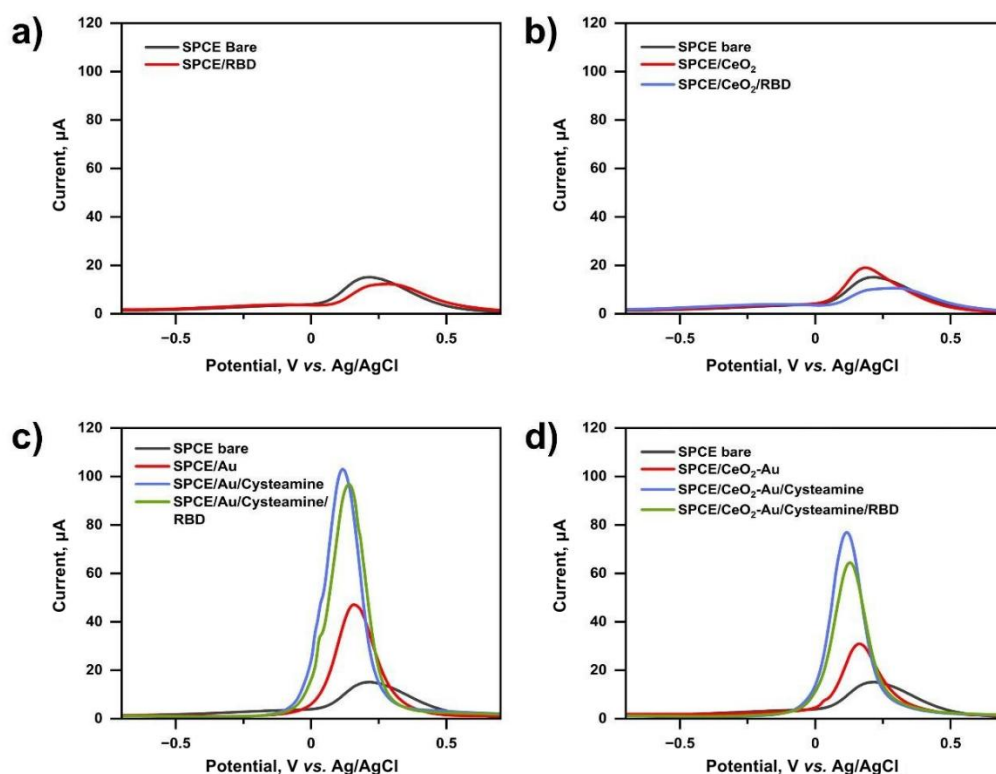


Figure S1. Differential pulse voltammograms of each modification stage for (a) unmodified SPCE (SPCE bare), and SPCEs modified with (b) CeO₂, (c) AuNP and (d) CeO₂-Au with the same suspension/colloidal concentration using [Fe(CN)₆]^{3+/4+} 10 mM redox system in 0.1 M KCl

Table S1. Data on the peak height of potassium ferricyanide on variations in IgG concentrations

IgG concentration, ng mL ⁻¹	log (C _{IgG} / pg mL ⁻¹)	ΔI ± SD / μA
0.01	1	9.423 ± 1.676
0.1	2	13.219 ± 0.816
1	3	15.945 ± 0.587
10	4	19.659 ± 1.917
100	5	24.066 ± 1.372
1000	6	27.508 ± 0.732

Linier regression :

$$y = 3.666x + 5.377$$

$$\text{Standard error} = \sqrt{\frac{\sum (y - y_{\text{predict}})^2}{N-2}} = 0.469$$

$$\sigma \text{ intercept} = \text{SE} \sqrt{\frac{\sum Xi^2}{N \sum (x - \bar{x})^2}} = 0.437$$

$$\text{LoD} = \frac{3\sigma}{\text{Slope}} = 2.475 \text{ pg mL}^{-1}$$

$$\text{LoQ} = \frac{10\sigma}{\text{Slope}} = 15.588 \text{ pg mL}^{-1}$$

Table S2. Precision data

IgG concentration, ng mL ⁻¹	$\Delta I / \mu\text{A}$	Average $\Delta I \pm \text{SD} / \mu\text{A}$
1.0	11.910	15.129 ± 1.915
	15.267	
	16.286	
	16.283	
	17.094	
	13.941	

$$\text{CV}^* = \frac{SD}{I} 100 = 2.855 \%$$

$$\text{Precision} = 100 - \text{CV} = 97.145 \%$$

*In probability theory and statistics, the coefficient of variation (CV), also known as relative standard deviation (RSD)

Accuracy

$$X_{\text{observed}} = 2.66$$

$$X_{\text{true}} = 3$$

$$\text{Error} = \left| \frac{X_{\text{observed}} - X_{\text{true}}}{X_{\text{true}}} \right| 100 = 11.326 \%$$

$$\text{Accuracy} = 100 - \text{Error} = 88.674 \%$$

Table S3. Results of fractional design with eight experiments under different immunosensor storage conditions

No	Addition of stabilizing solution	Packaging	Temperature, °C	Humidity	$\Delta I \pm \text{SD} / \mu\text{A}$
1	Yes	Open	4 to 5	Low	41.648 ± 4.367
2	No	Closed	4 to 5	Low	1.373 ± 4.344
3	No	Closed	RT	Normal	25.156 ± 1.441
4	No	Open	4 to 5	Normal	12.299 ± 1.597
5	No	Open	RT	Low	26.465 ± 0.480
6	Yes	Closed	RT	Normal	48.603 ± 0.304
7	Yes	Closed	RT	Low	35.580 ± 5.645
8	Yes	Open	RT	Normal	53.250 ± 0.669

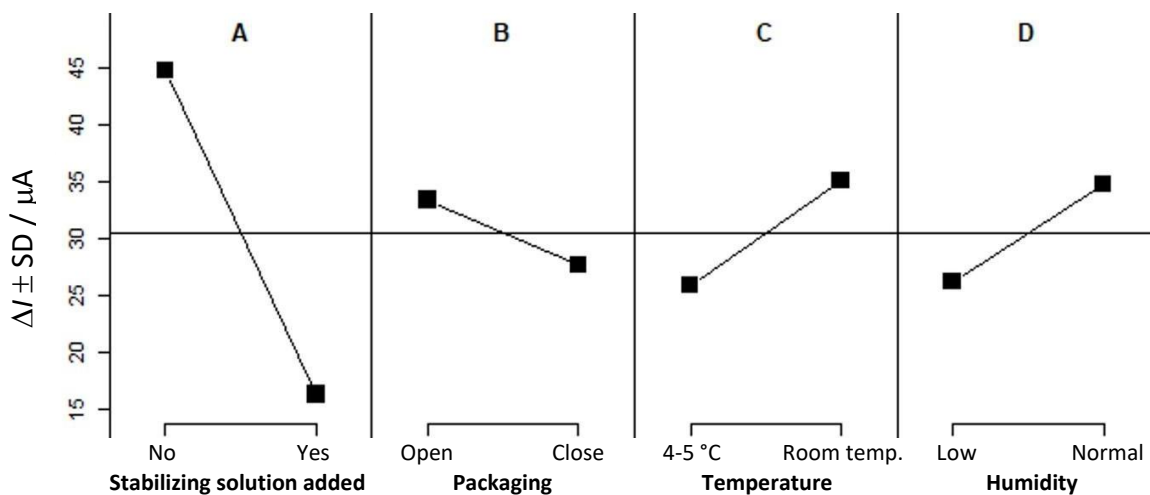


Figure S2. Main effect plot based on immunosensor storage factors for one week against current change response. (Factors: A = addition of stabilizing solution, B = packaging, C = temperature and D = humidity).

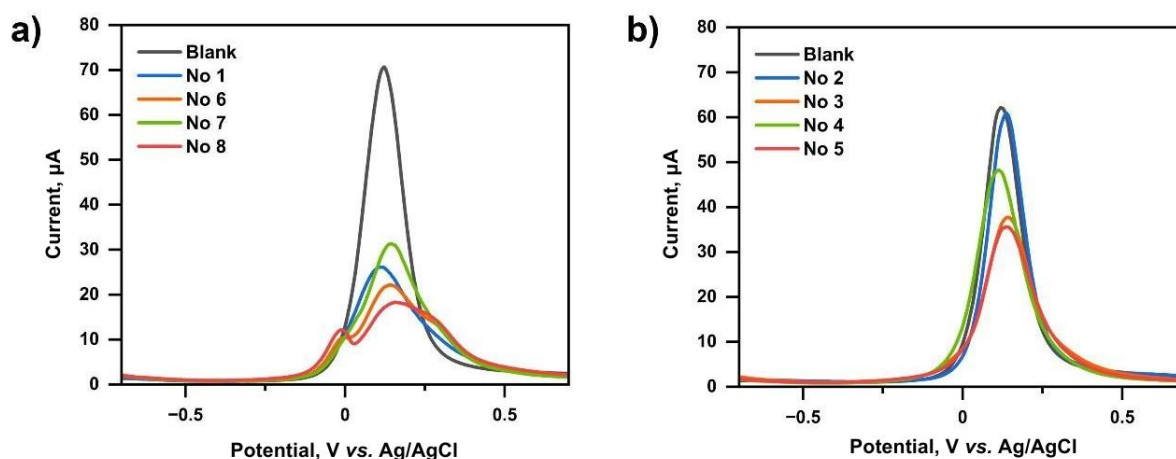


Figure S3. Differential pulse voltammogram with differences in the addition of stabilizer solutions in eight fractional design experiments where (a) using stabilizer solutions (consisting of NaN_3 , Na_2EDTA , BSA and PBS) and (b) not using stabilizing solutions using redox systems $[Fe(CN)_6]^{3+/4+}$ 10 mM in KCl 0.1 M