

Supplementary Materials

Voltammetric Sensor Based on the Combination of Tin and Cerium Dioxide Nanoparticles with Surfactants for Quantification of Sunset Yellow FCF

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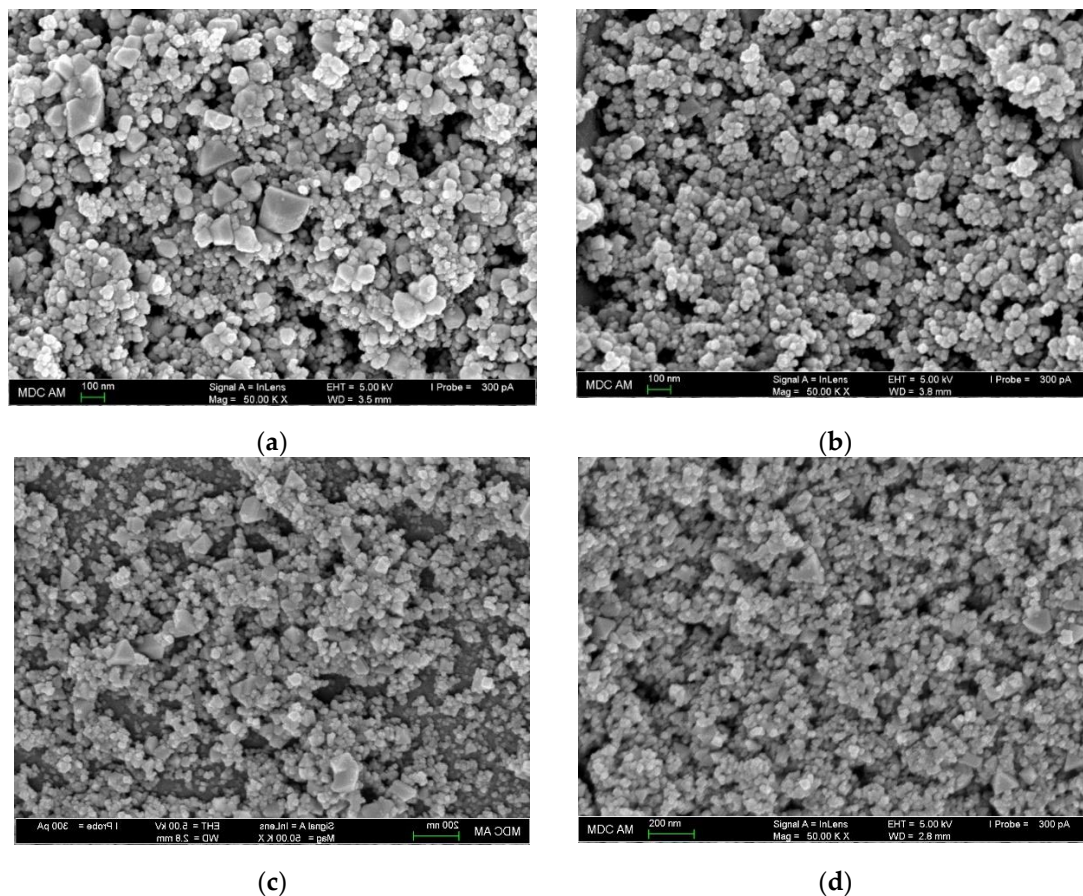


Figure S1. Field emission scanning electron microscopy images of the electrode surface: (a) GCE//SnO₂ NPs; (b) GCE/SnO₂ NPs-HDPB; (c) GCE/CeO₂ NPs; (d) GCE/CeO₂ NPs-HDPB. Magnification is 50,000 \times .

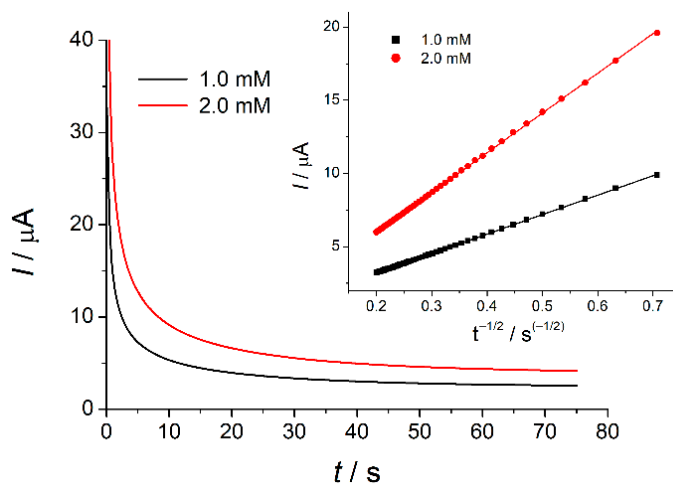


Figure S2. Chronoamperograms of hexacyanoferrate(II) ions in 0.1 M KCl on the bare GCE at 450 mV. The inset is the plot of I vs. $t^{-1/2}$.

Diffusion coefficient has been calculated from the Equation S1

$$I_{p_{ox}} = \pi^{1/2} \chi(bt) n F A c D^{1/2} \left(\frac{\alpha_a n_a F}{RT} \right)^{1/2} v^{1/2} \quad (S1)$$

where I_{ox} – oxidation peak current (A), $\chi(bt)$ – normalized current for sweep experiments with an irreversible system, n – the number of electrons participating in oxidation, F – the Faraday constant ($C \text{ mol}^{-1}$), A – the electrode surface area (cm^2), c – concentration (mol cm^{-3}), D – diffusion coefficient ($\text{cm}^2 \text{ s}^{-1}$), α_a – anodic transfer coefficient, n_a – the number of electrons involved in the rate-determining step, R – the gas constant ($J \text{ mol}^{-1} \text{ K}^{-1}$), T – temperature (K) and v – potential scan rate ($V \text{ s}^{-1}$).

The standard heterogeneous electron transfer rate constant k^0 has been calculated using Equation S2

$$k^0 = 2.415 e^{-\frac{0.02F}{RT}} D^{1/2} (E_p - E_{p1/2})^{-1/2} v^{1/2} \quad (S2)$$

where k^0 is the standard heterogeneous electron transfer rate constant (cm s^{-1}), D – diffusion coefficient ($\text{cm}^2 \text{ s}^{-1}$), E – the oxidation potential (V), $E_{1/2}$ – the oxidation half-wave potential (V), other symbols have the same meaning as in Equation S2.

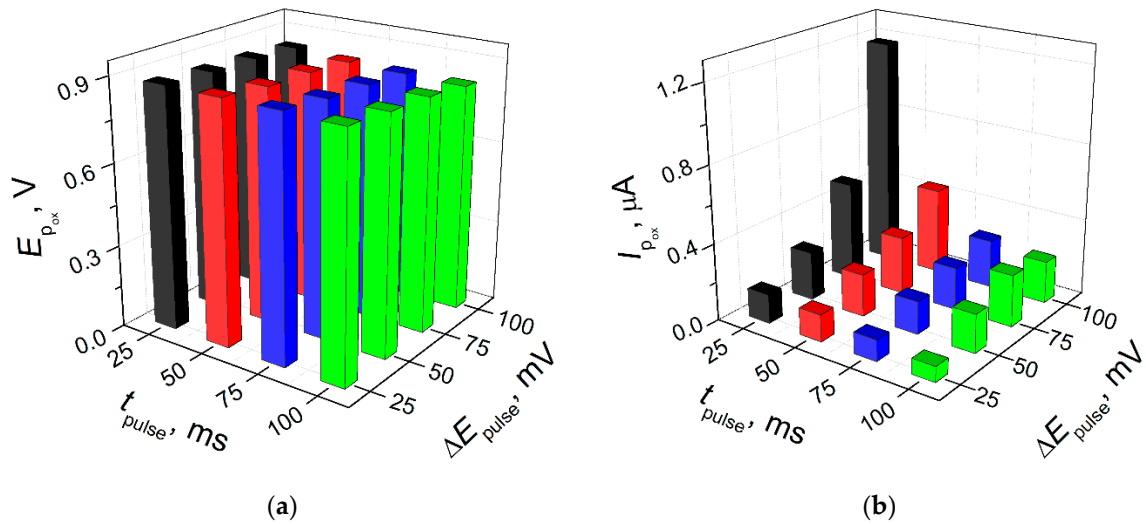


Figure S3. Effect of pulse parameters on the voltammetric characteristics of 1.0 μM SY FCF at the GCE/SnO₂-CeO₂ NPs-HDPB in BRB pH 2.0: (a) the changes in the oxidation peak potential; (b) the changes in the oxidation peak currents. $v = 0.010 \text{ V s}^{-1}$.

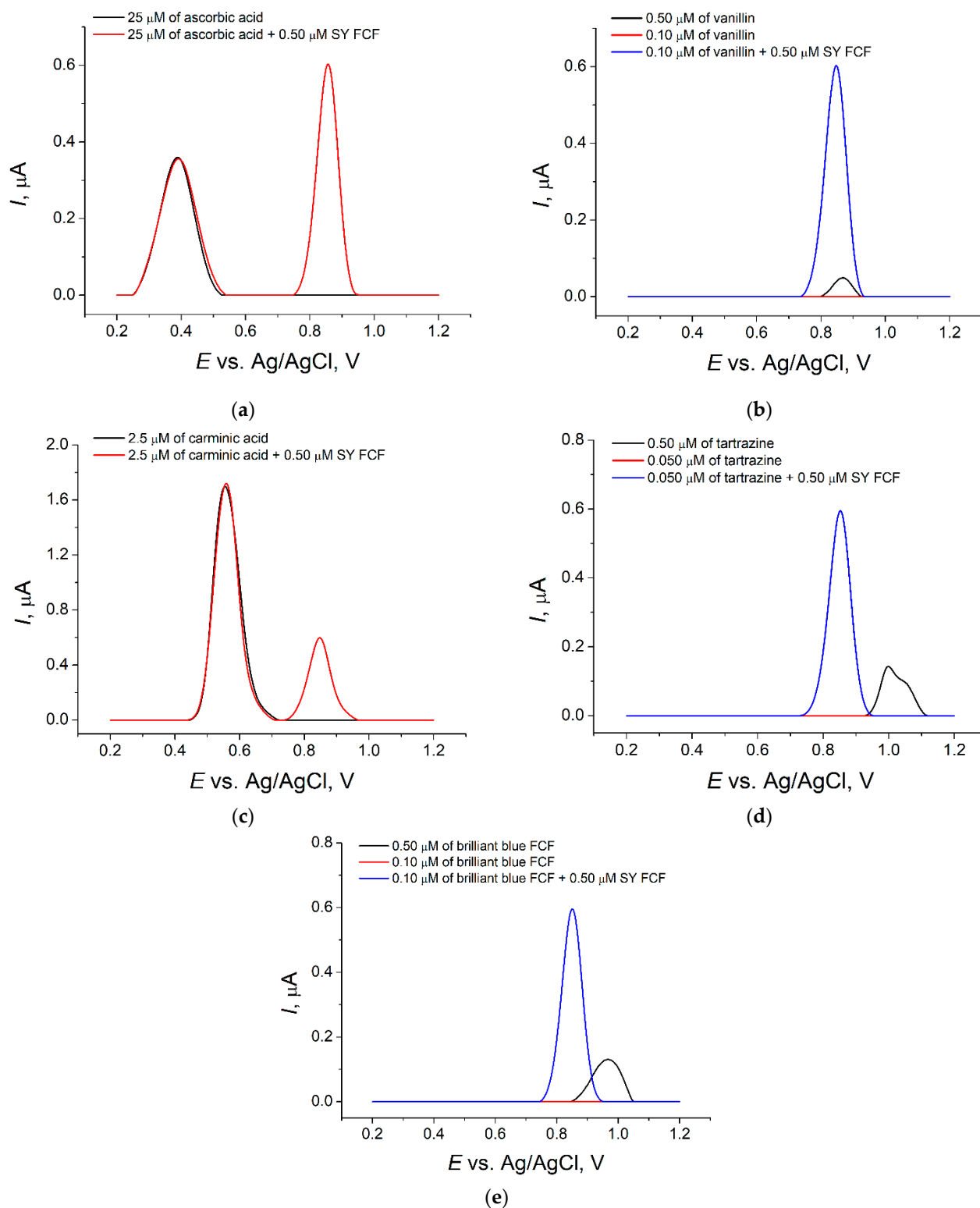


Figure S4. Baseline-corrected differential pulse voltammograms of interferences and their mixtures with SY FCF at the GCE/SnO₂-CeO₂ NPs-HDPB in BRB pH 2.0: (a) ascorbic acid; (b) vanillin; (c) carminic acid; (d) tartrazine; (e) brilliant blue FCF. Pulse amplitude is 100 mV, pulse time is 25 ms, potential scan rate is 0.010 V s⁻¹.

Table S1. Recovery of SY FCF in soft drinks ($n = 5$; $P = 0.95$).

Sample	Spiked, nM	Found, nM	RSD, %	R, %
Sample 1	0	100 ± 5	4.3	
	50	150 ± 6	3.1	100 ± 4
	100	201 ± 4	1.7	101 ± 2
Sample 2	0	176 ± 3	1.2	
	90	266 ± 6	1.9	100 ± 2
	170	345 ± 3	0.55	99.8 ± 0.9
Sample 3	0	31 ± 1	3.5	
	16	47 ± 2	3.1	100 ± 4
	31	62 ± 1	1.4	100 ± 2