applied sciences

MDPI

Supplementary material

One-Step Fabrication of Nickel-Electrochemically Reduced Graphene Oxide Nanocomposites Modified Electrodes And Application to the Detection of Sunset Yellow in Drinks

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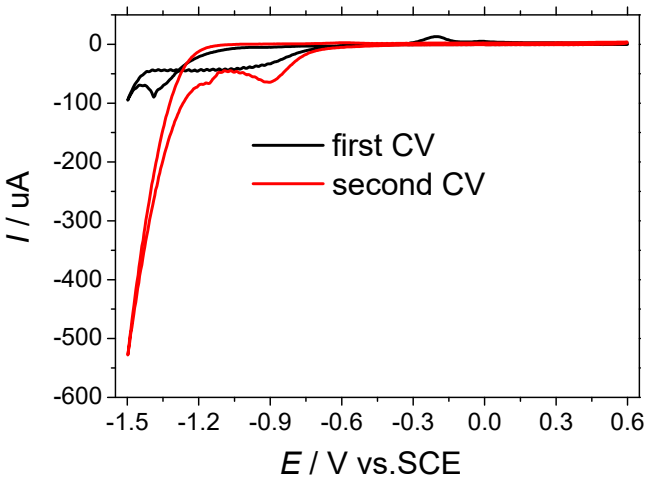


Figure S1. First and second CVs (scan rate = 50 mV s-1) of GCE in 0.1 M LiClO4 containing 1 mg ml^{-1} GO + 0.5 mM $NiCl_2$.

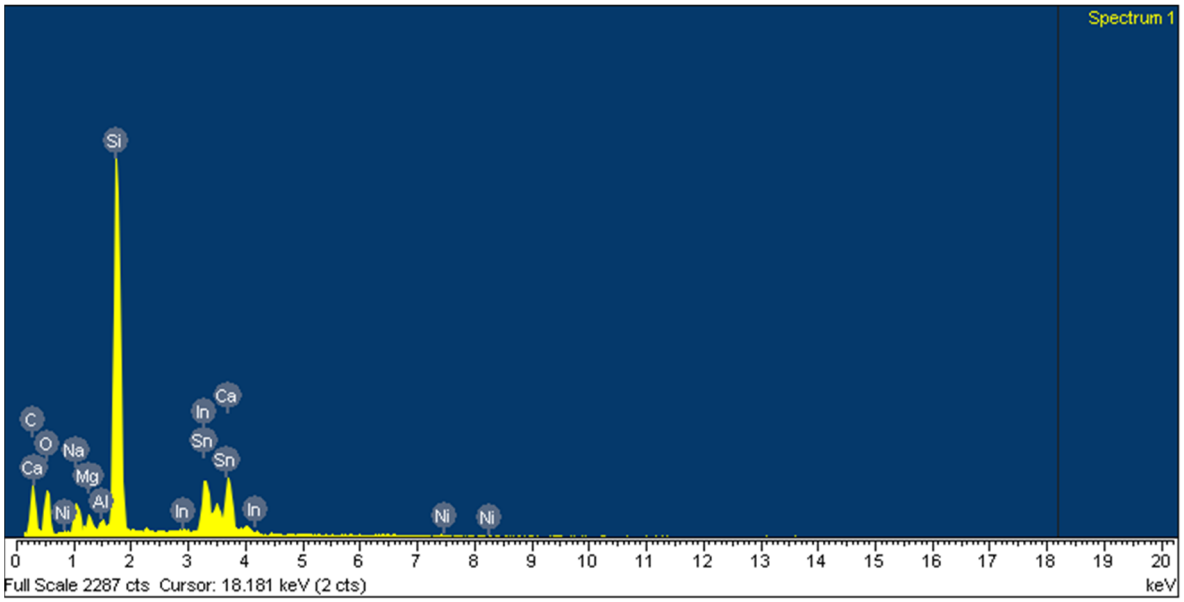


Figure S2. EDX of ERGO-NiNPs deposited onto ITO substrate using 10 CV scans between +0.6 ÷ -1.5V/SCE in 0.1 M $LiClO_4$ electrolyte solution containing 1 (mg mL^{-1}) GO + 0.5 mM $NiCl_2$.

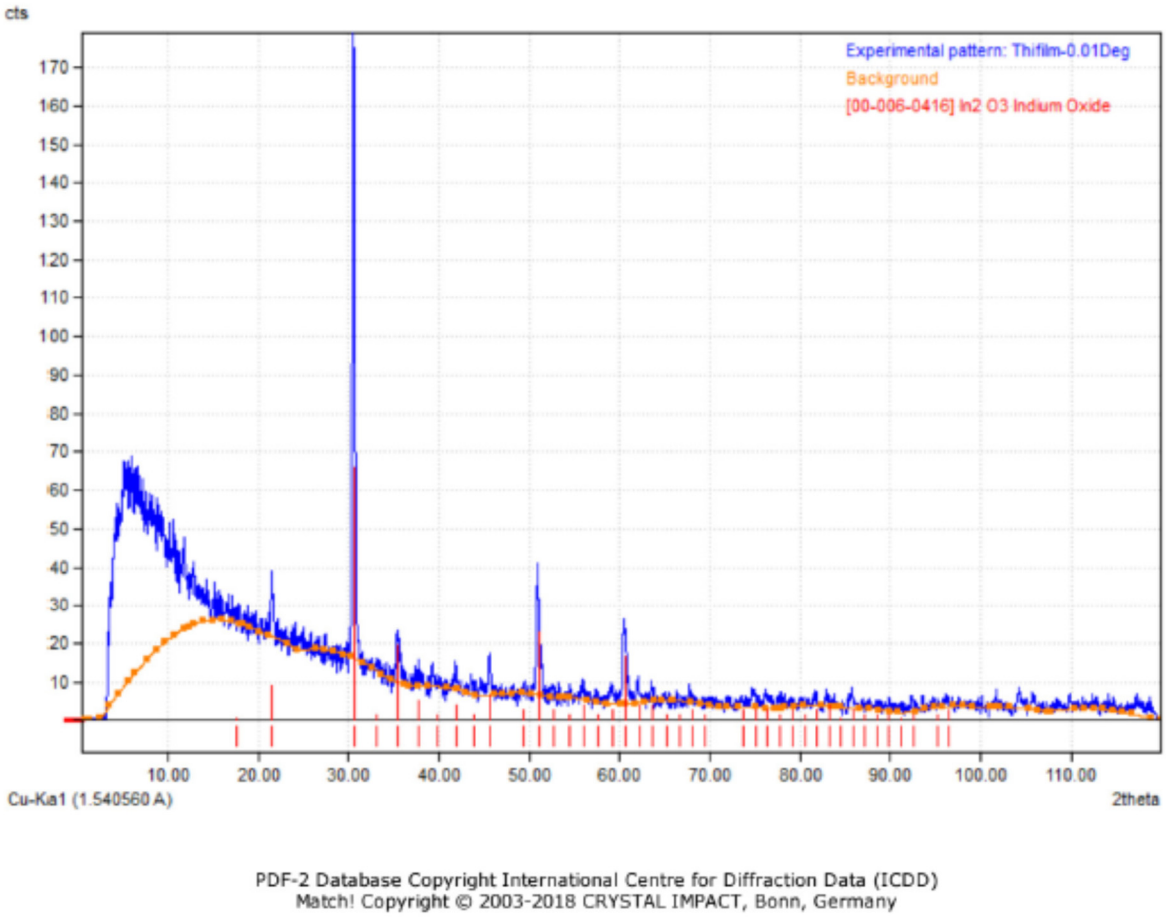


Figure S3. XRD pattern of ERGO-NiNPs deposited onto ITO substrate using 10 CV scans between +0.6 ÷ -1.5V/SCE in 0.1 M $LiClO_4$ electrolyte solution containing 1 (mg mL^{-1}) GO + 0.5 mM $NiCl_2$.

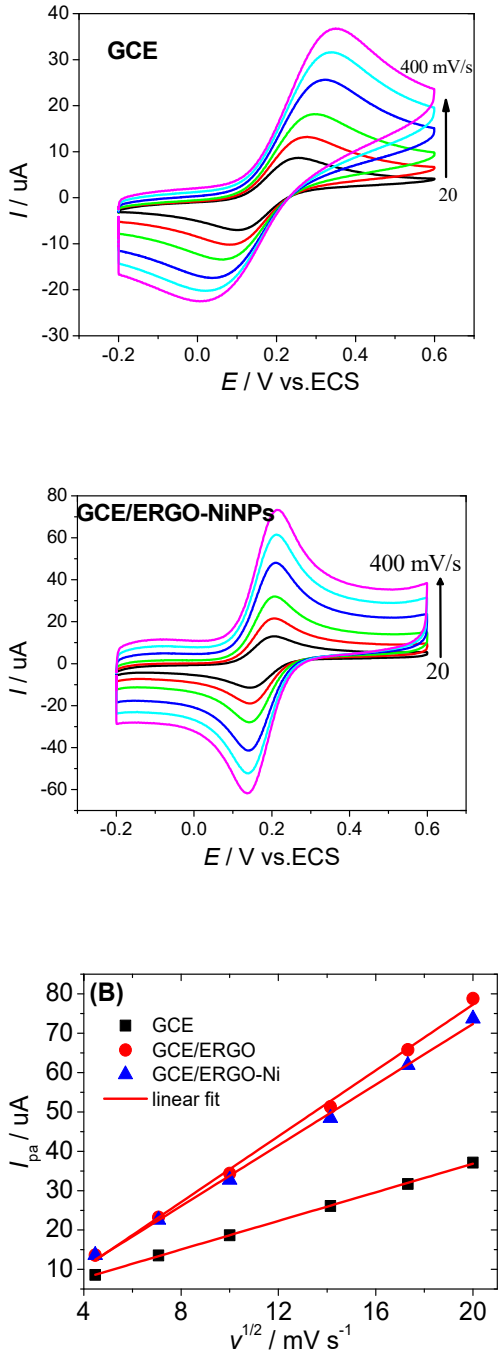


Figure S4. Cyclic voltammograms of GCE, GCE/ERGO and GCE/ERGO-NiNPs in 0.1 mM KCl + 1 mM K3Fe(CN)6/K4Fe(CN)6 with the scan rate varying from 20 to 400 mV s-1 namely, 20 (black), 50 (red), 100 (green), 200 (blue), 300 (cyan), 400 (magenta) mV s-1. And (B) Variation of the peak currents towards square root of the scan rate.

The electrochemically active surface areas (ECSA) could be calculated according to Randles-Sevcik equation:

Ipa = 2.69 × 105n3/2AD1/2Cv1/2

where Ipa is the anodic peak current (A); n is the number of electron transferred (here n = 1), A is the electrochemical surface area (cm2), D (7.6 × 10-6 cm2 s-1) is the diffusion coefficient, v (V s^{-1}) is the scan rate, and C (mol dm^{-3}) is the concentration of the redox probe in bulk solution.

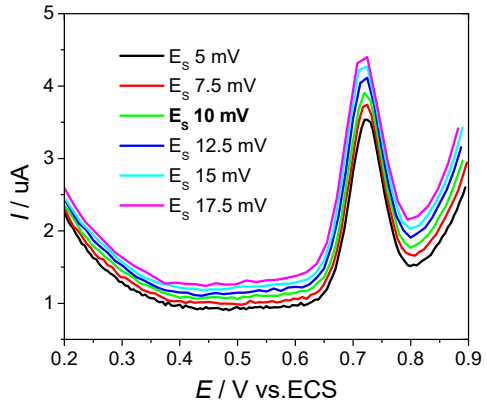


Figure S5. DPV of GCE/ERGO-NiNPs surface in acetate buffer pH 4 + 0.5 μM SY at different scan rates from v = 10-35 mV.s^{-1} (Es varying from 5 to 17.5 mV; ts = 500 ms; Ep = 50 mV; tp = 200 ms, Idt = 100 ms). Accumulation time of 2 minutes at 0 V/SCE.

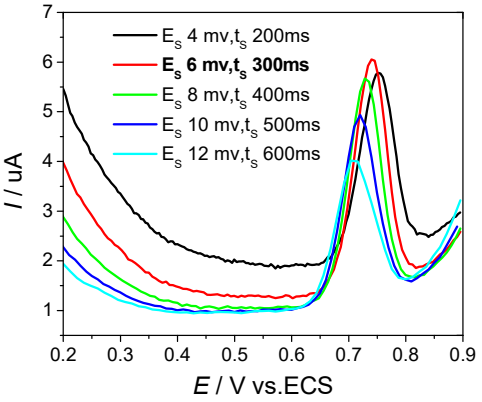


Figure S6. DPV of GCE/ERGO-NiNPs surface in acetate buffer pH 4 + 0.5 μM SY at scan rate v = 20 mV s^{-1} with different step potentials from Es = 4–12 mV, ts/tp/Ep/Idt = 10/4/1/2. Accumulation time of 2 minutes at 0 V/ECS.

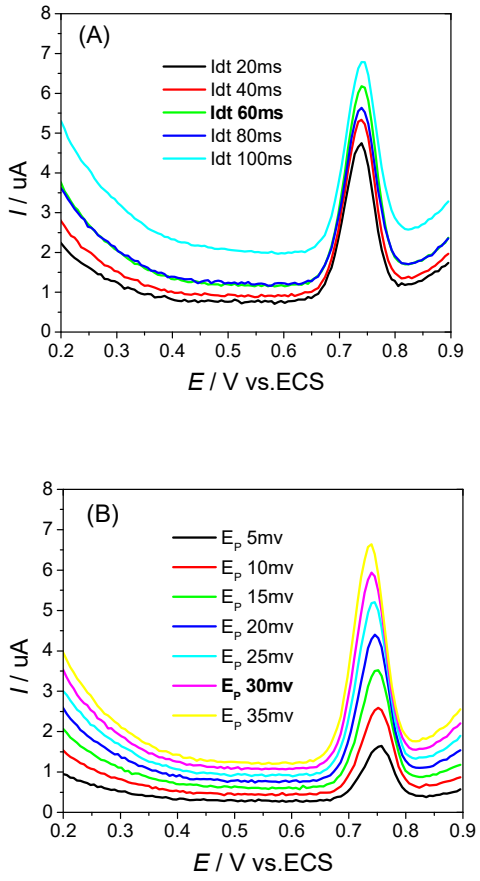


Figure S7. DPV of GCE/ERGO-NiNPs surface in acetate buffer pH 4 + 0.5 μM SY at scan rate v = 20 mV s^{-1}, Es = 6 mV, ts = 300 ms, and tp = 120 ms, accumulation time of 2 minutes at 0 V/ECS: (A) Ep = 30 mV at different Idt = 20 - 100 ms. (B) Idt = 60 ms at different Ep = 5-35 mV.

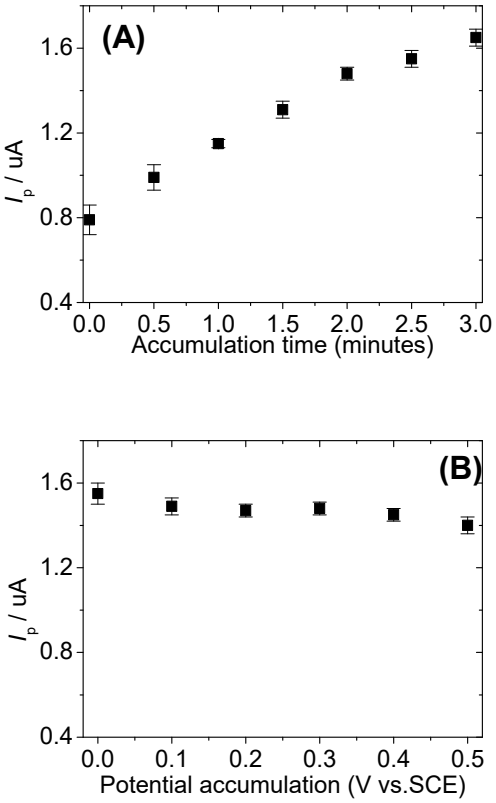
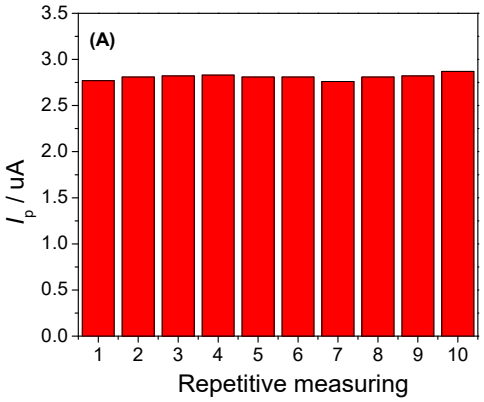
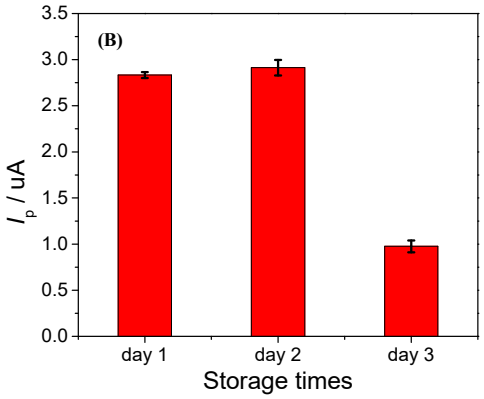
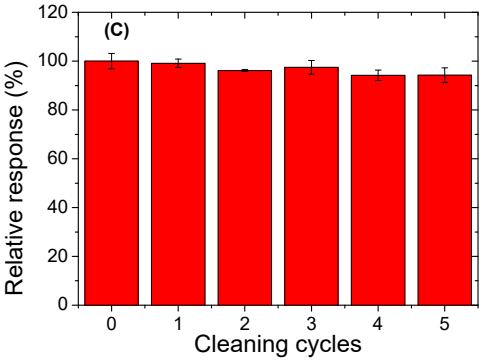


Figure S8. DPV responses of GCE/ERGO-NiNPs modified electrode in acetate buffer pH 4 + 0.5 uM SY using optimsed DPV parameters with scan rate v = 20 mV s^{-1}, Es = 6 mV, ts = 300 ms, Ep = 30 mV, tp = 120 ms and Idt = 60 ms: (A) variation of accumulation time at a potential accumulation of 0 V/SCE (B) variation of potential accumulation with accumulation time of 2 minutes. Error bar represents the standard deviation for three successive measurements.


(A)
I_p / uA
Repetitive measuring


(B)
I_p / uA
day 1
day 2
day 3
Storage times


(C)
Relative response (%)
Cleaning cycles

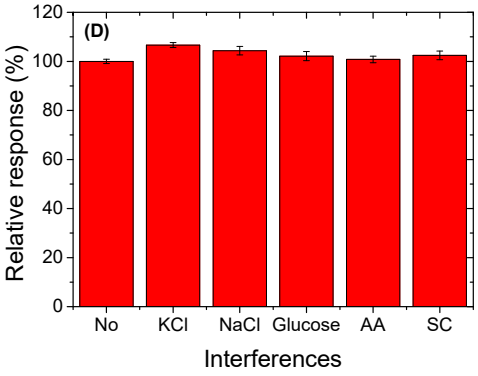

(D)
Relative response (%)
No
KCl
NaCl
Glucose
AA
SC
Interferences

Figure S9. DPV response of the GCE/ERGO-NiNPs sensor in acetate buffer pH 4 + 0.5 uM SY under optimized conditions: v = 20 mV s^{-1}, Es = 6 mV, ts = 300 ms, Ep = 30 mV; tp = 120 ms and Idt = 60 ms, accumulation time of 2 minutes at 0 V/ECS. (A) Repetitive measuring (B) storage stability in buffer solution (C) repetitive measuring/cleaning cycles (D) with the presence of 100-folds concentration KCl, NaCl, acid ascobic (AA), glucose (Glu) and sodium citrate (SC).