## Supporting information

# Disposable electrode modified with metal orthovanadate and sulfur-reduced graphene oxide for electrochemical detection of sulfasalazine

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# EXPERIMENTAL SECTION

## Reagents and Chemicals

Cerium (III) nitrate hexahydrate ($Ce(NO_3)_3 \cdot 6H_2O$, ACS reagent, ≥99.0%), $NH_4VO_3$, and other chemicals were bought from Sigma-Aldrich, USA. Potassium ferricyanide ($K_3[Fe(CN)_6]$), potassium ferrocyanide ($K_4[Fe(CN)_6]$), and potassium chloride (KCl) were analar grade commercial products, used as received. For those experiments in which supporting electrolyte was present, KCl was added to remain a 5.0 mM concentration. The electrolyte, 0.05 M phosphate buffer saline (PBS, pH 7.0) was prepared by mixing, sodium mono-hydrogen phosphate ($Na_2HPO_4$) and sodium dihydrogen phosphate ($NaH_2PO_4$) in an aqueous medium. The pH of the electrolyte solution was adjusted by using aqueous $H_2SO_4$ (0.5 M) and NaOH (2.0 M). The entire experiments were done with freshly prepared Milli-Q water (18.2 MQ $cm^{-1}$, specific resistivity) collected from Millipore Water System.

## Characterizations

The nanostructure, composition and the morphological characterization of CVO@SRG composite was evaluated by the high resolution-transmission electron microscopy (HR-TEM) H-7600, Hitachi, (Japan). The chemical composition and elemental percentage were assessed through energy-dispersive X-ray (EDX) which affiliated with HR-TEM. The crystalline phase of as prepared samples was analyzed by X-ray diffraction (XRD) XPERT-PRO (PAN analytical B.V. The Netherlands) diffractometer with Cu M radiation (k = 1.54 Å). The oxidation state and the composition of the materials was scrutinized by X-ray photoelectron spectroscopy (XPS, Thermo ESCALAB 250 instrument).

**Electrochemical Apparatus**

The cyclic voltammetry (CV) and differential pulse voltammetry (DPV) experiments were carried out on a CHI 1205A analyzer electrochemical workstation (CH, USA). A conventional three-electrode system consisting of an Ag/AgCl (saturated KCl) electrode as the reference electrode, a platinum wire as the auxiliary electrode, and a CVO@SRG modified SPCE as the WE were used (Scheme 2).

**SGR preparation**

The graphene oxide (GO) was prepared by modified Hummers method from the graphite powder. Then, 10 mg of as-prepared GO was re-dispersed in 10 mL of de-ionized water and this suspension was ultrasonicated for 40 min. Further, the 5 mL of 1 M $Na_2S$ was added to the suspension. Then, the reaction mixture was ultrasonicated for 2 h at 100 °C. Now the graphene oxide turned to S doped reduced graphene oxide sheets (SRG) and the SRG was separated by centrifugation.

## CVO crystal structure information

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Title Ce $O_4$ V

Lattice type I
Space group name I 41/a m d
Space group number 141
Setting number 1

Lattice parameters

| a | b | c | alpha | beta | gamma |
|---|---|---|---|---|---|
| 7.34000 | 7.34000 | 6.47000 | 90.0000 | 90.0000 | 90.0000 |

Unit-cell volume = 348.575135 Å^3

Structure parameters

| | | x | y | z | Occ. | U | Site | Sym. |
|---|---|---|---|---|---|---|---|---|
| 1 | O O1 | 0.00000 | 0.19000 | 0.35000 | 1.000 | 0.020 | 16h | .m. |
| 2 | Ce Ce1 | 0.00000 | 0.00000 | 0.00000 | 1.000 | 0.020 | 4a | -4m2 |
| 3 | V V1 | 0.00000 | 0.00000 | 0.50000 | 1.000 | 0.020 | 4b | -4m2 |

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Number of polygons and unique vertices on isosurface = 0 (0)
107 atoms, 144 bonds, 23 polyhedra; CPU time = 3 ms

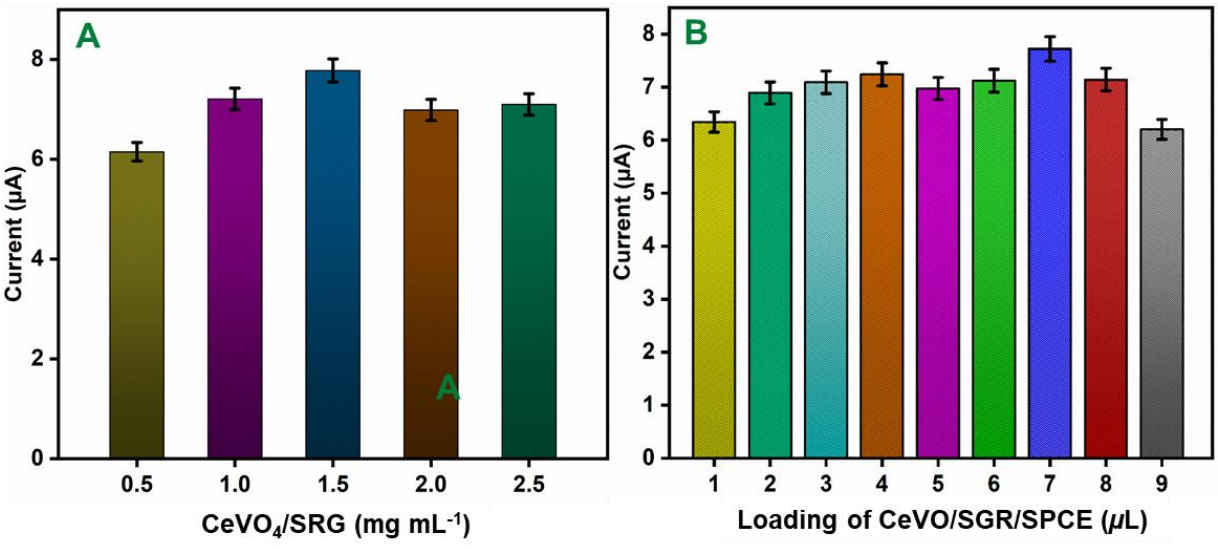


**Fig. S1. Optimization of the electrochemical experiments (A): effect of concentrations of nanocomposite, (B): effect of catalyst.**

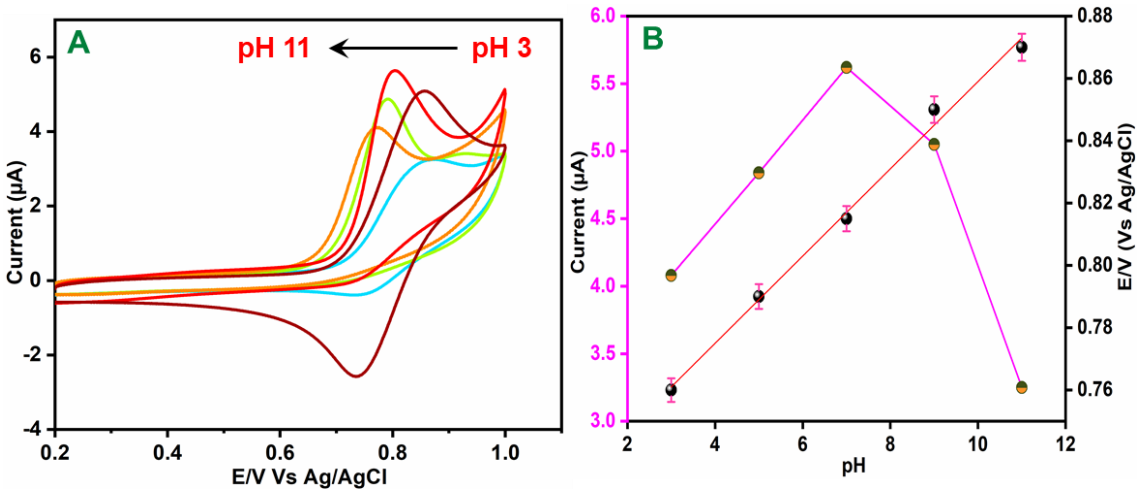


**Fig. S2. (A-B) Optimization of the electrochemical experiments effect of pH.**

Table 1. Analytical parameters for the determination of SSZ at CVO/SRG/SPCE with previous reports [14,17,19,32-36].

| | |
|---|---|
| **SbFE** | Antinomy film electrode |
| **BiNP-CNT** | Bismuth nanoparticle carbon nanotube |
| **MWCNTCOOH** | Functionalized multiwalled carbon nanotube |
| **GO/$Fe_3O_4$@$SiO_2$** | Graphene oxide/magneticle nanoparticle at silicon dioxide |
| **CD/RGO** | Beta cyclodextrin –reduced graphene oxide composite |
| **NiO** | Nickel oxide nanoparticle |

| | |
|---|---|
| **NiO/CNT** | Nickel oxide-carbon nanotube nano composite |
| **PtNPs/SWCNT** | Platinum nanoparticles on single walled carbon nanotube |