

Voltammetric electro-oxidation of diclofenac using graphitic carbon nitride-tungsten oxide (CNWO) nanocomposite platform

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Introduction

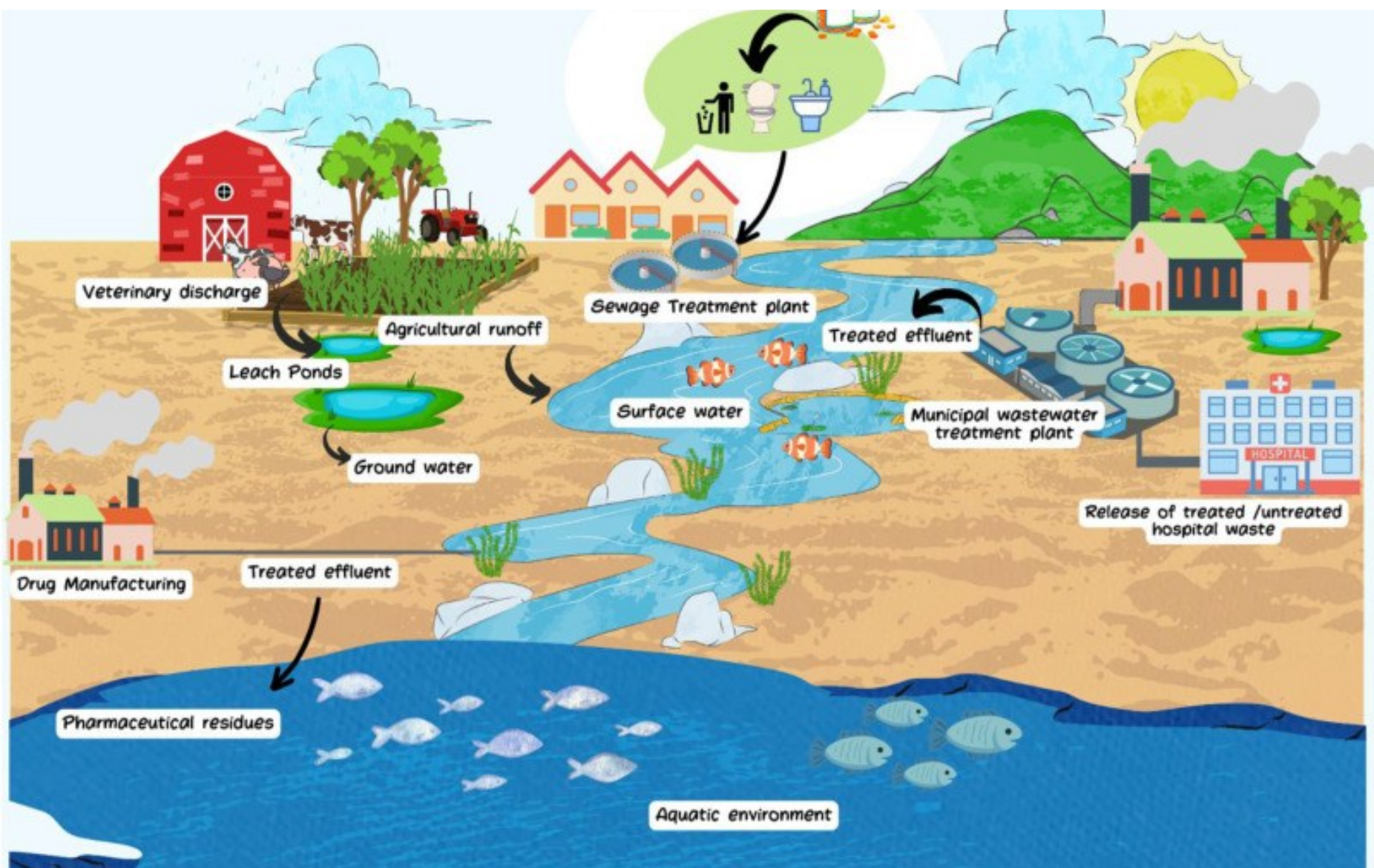


Fig. 1. Sources of diclofenac and other pharmaceuticals in water and effects in water bodies [1,2].

Effect of DFC in water bodies

- Can transform into toxic metabolites
- Harmful to aquatic animals
- Persistent in the environment
- Impact on soil and groundwater
- Bioaccumulate in the food chain

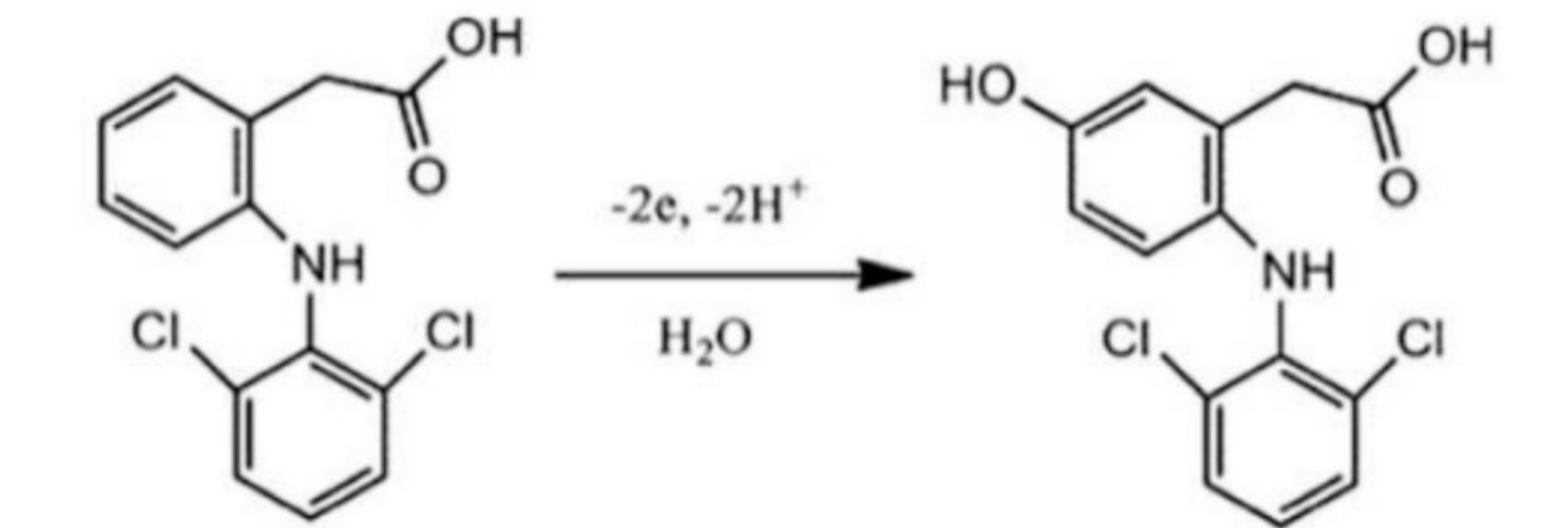


Fig. 2 Probable electrooxidation reaction of diclofenac [3].

Methodology

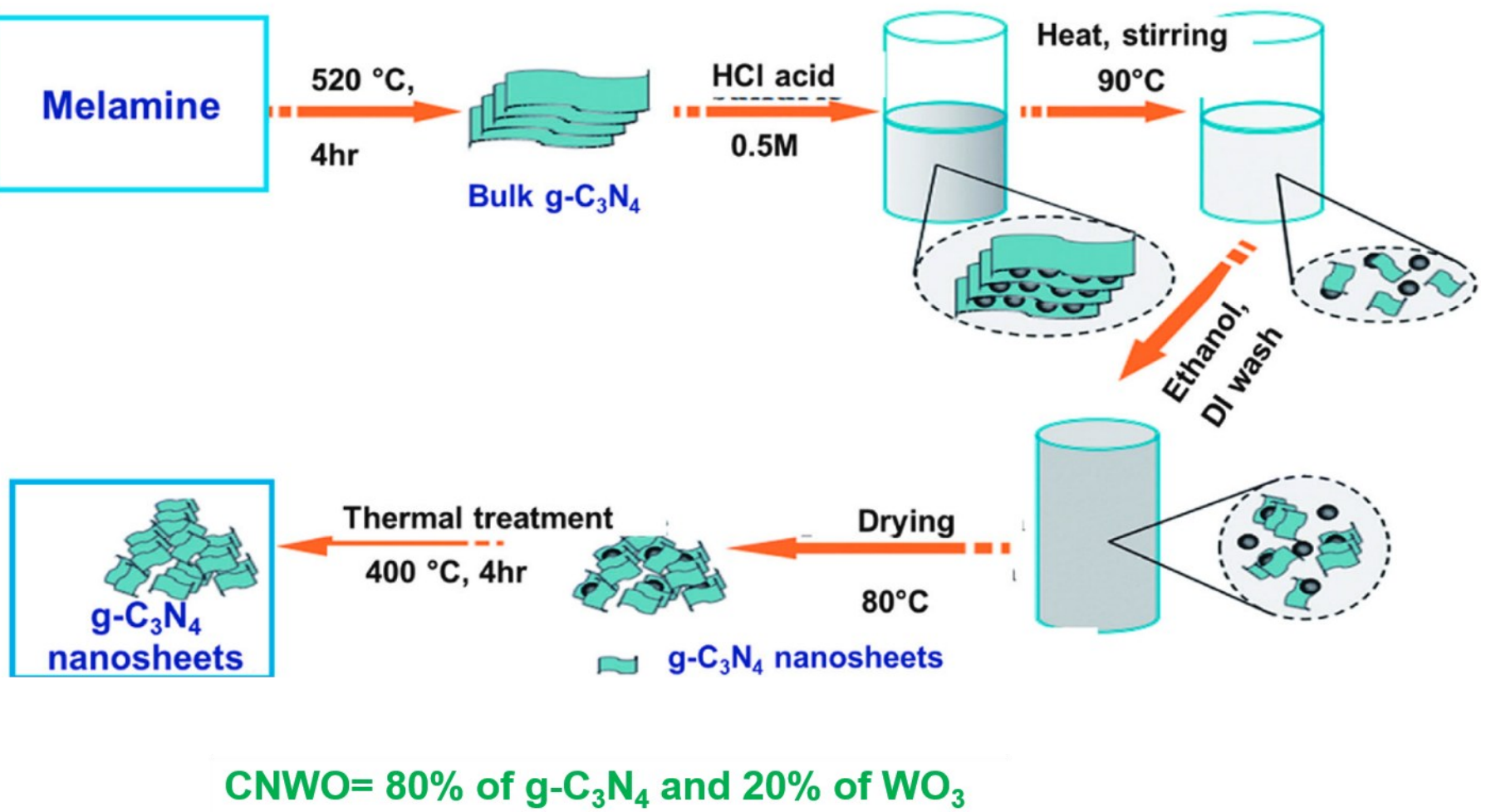


Fig. 3. Synthesis of the graphitic carbon nitride/tungsten oxide nanocomposite (CNWO) using a precipitation and calcination method.

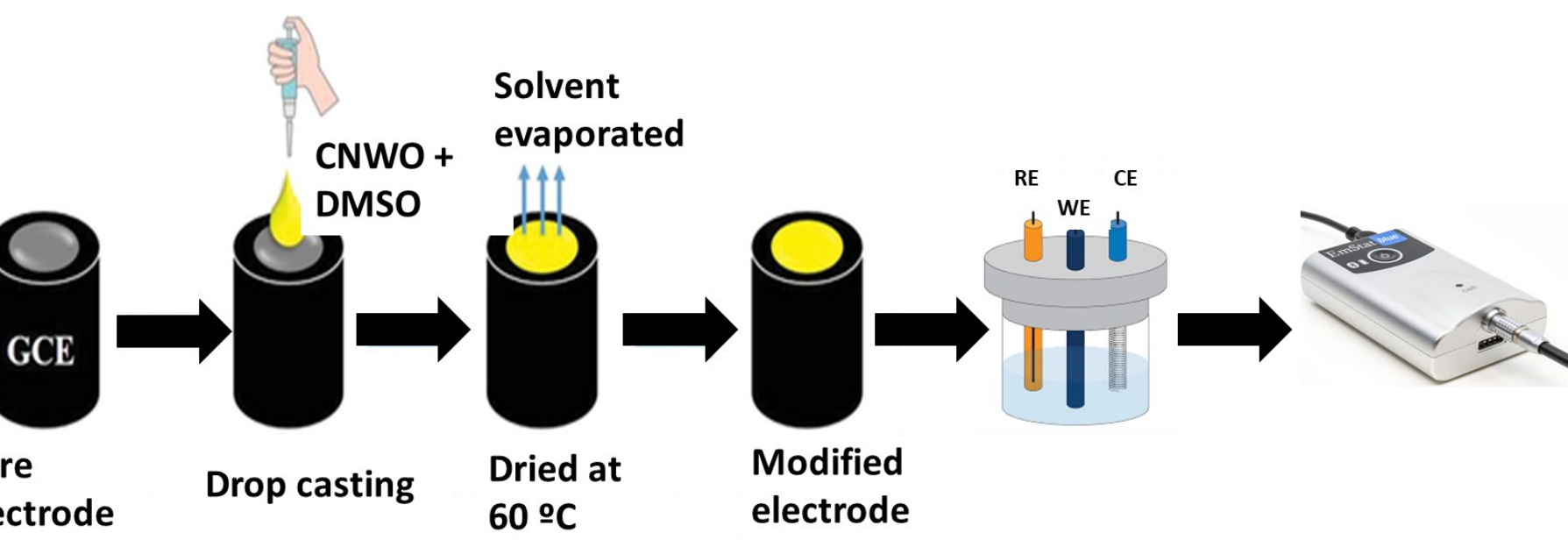


Fig. 4. The electrode fabrication process using drop-casting method and also indicating the electrochemical cell with the portable Palm-sens4 potentiostat.

Morphology of CNWO

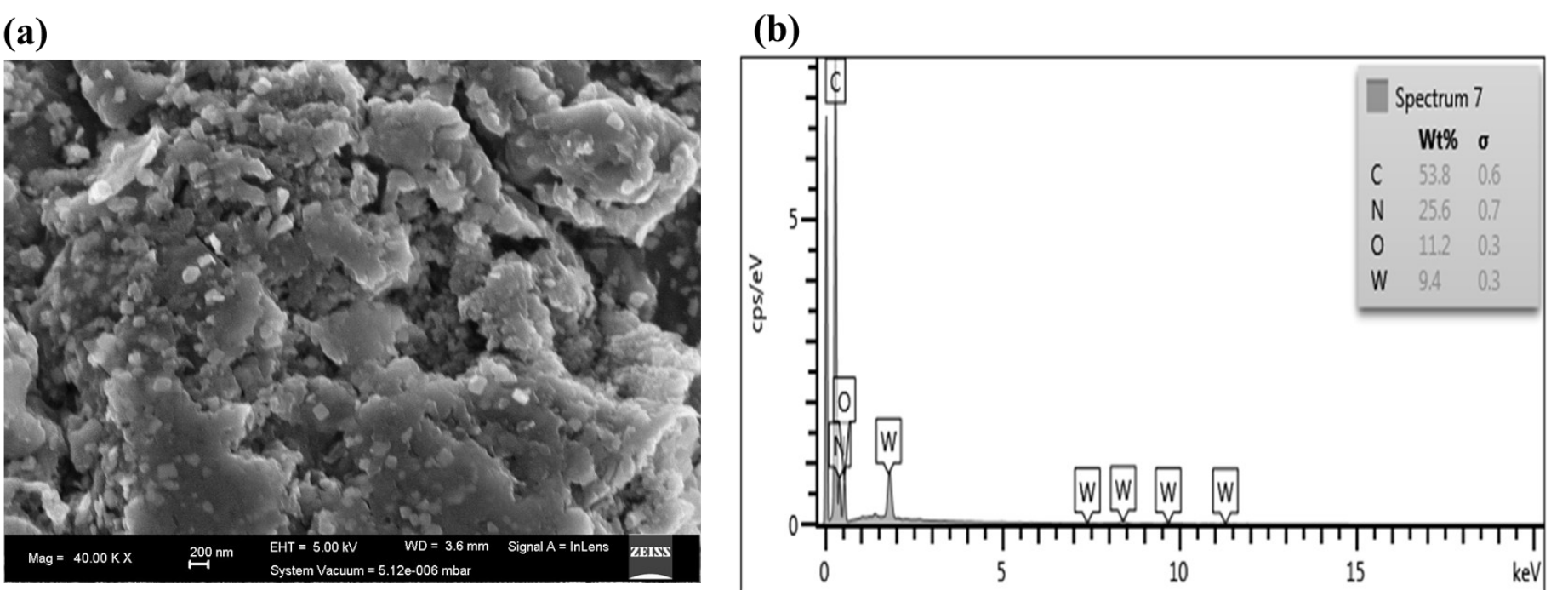


Fig. 5 The morphology results of CNWO. FE-SEM image of the nanocomposite (a) and EDX spectra (b).

Cyclic voltammetry analysis

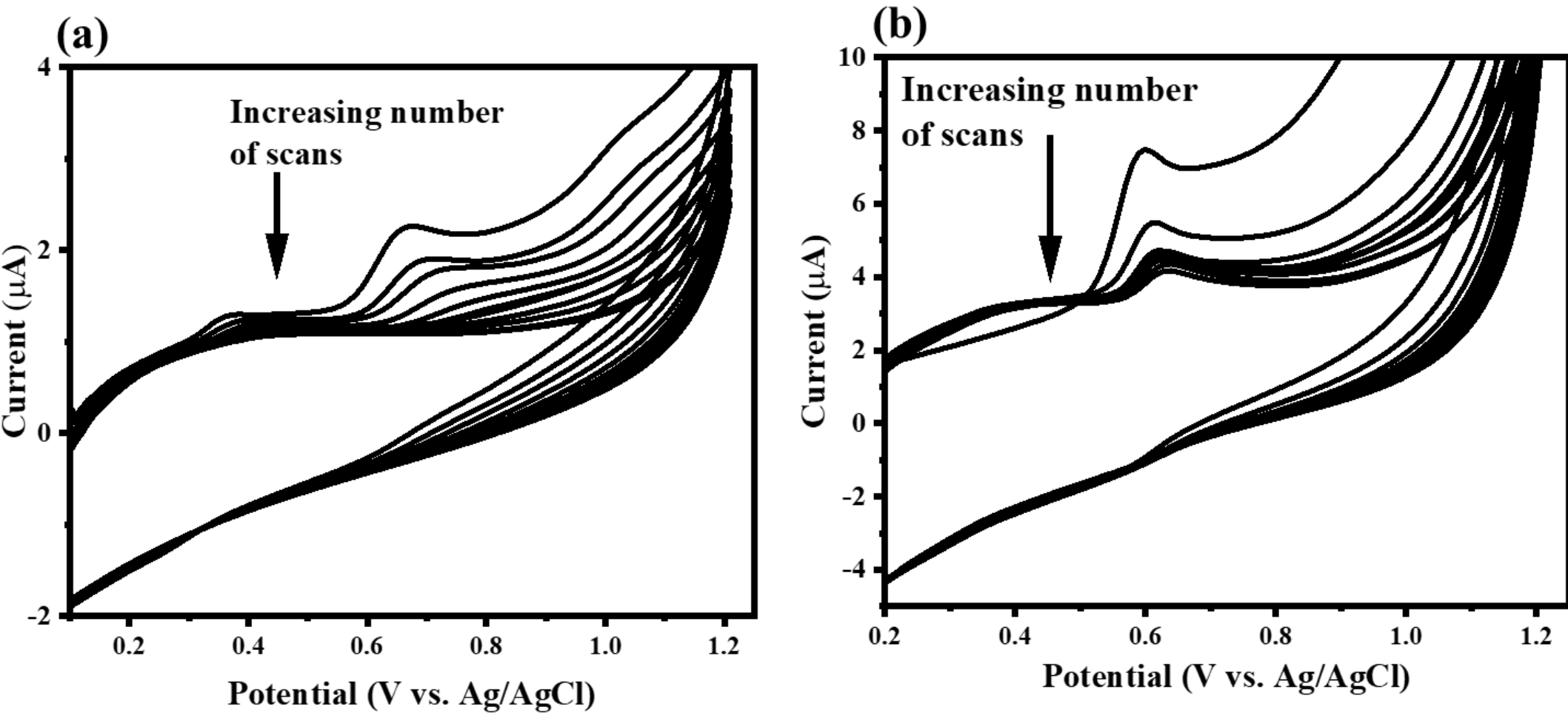


Fig. 6 CV curves of the unmodified and modified electrodes at 0.05 V/s voltammograms of 100 µM DFC performed at ten cycles for the unmodified GCE (a) and modified electrode with CNWO (b).

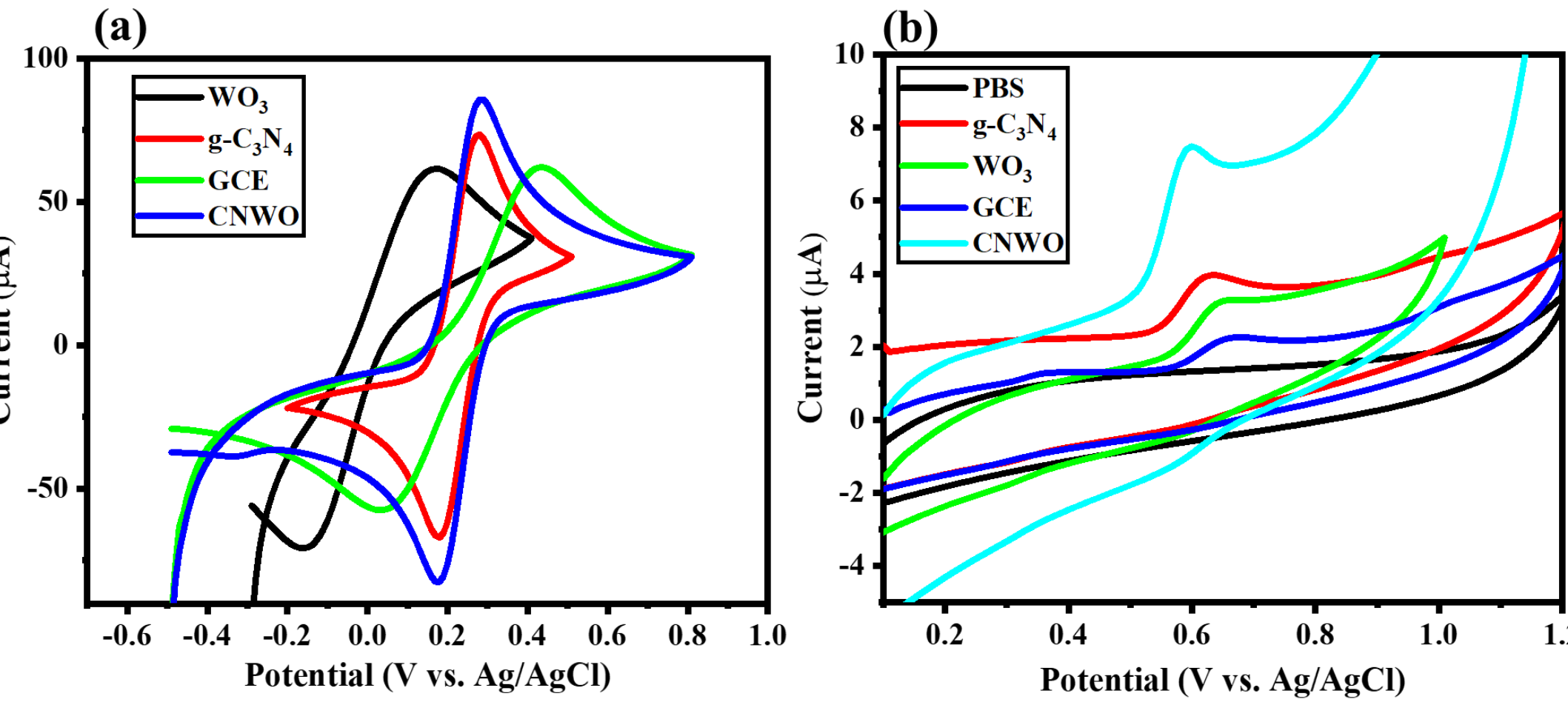


Fig. 7. Cyclic voltammetry curves of the unmodified and modified electrodes at 0.05 V/s in ferricyanide solution (a) and comparison of the oxidation peak of 100 µM DFC in phosphate buffer for the different electrodes (b).

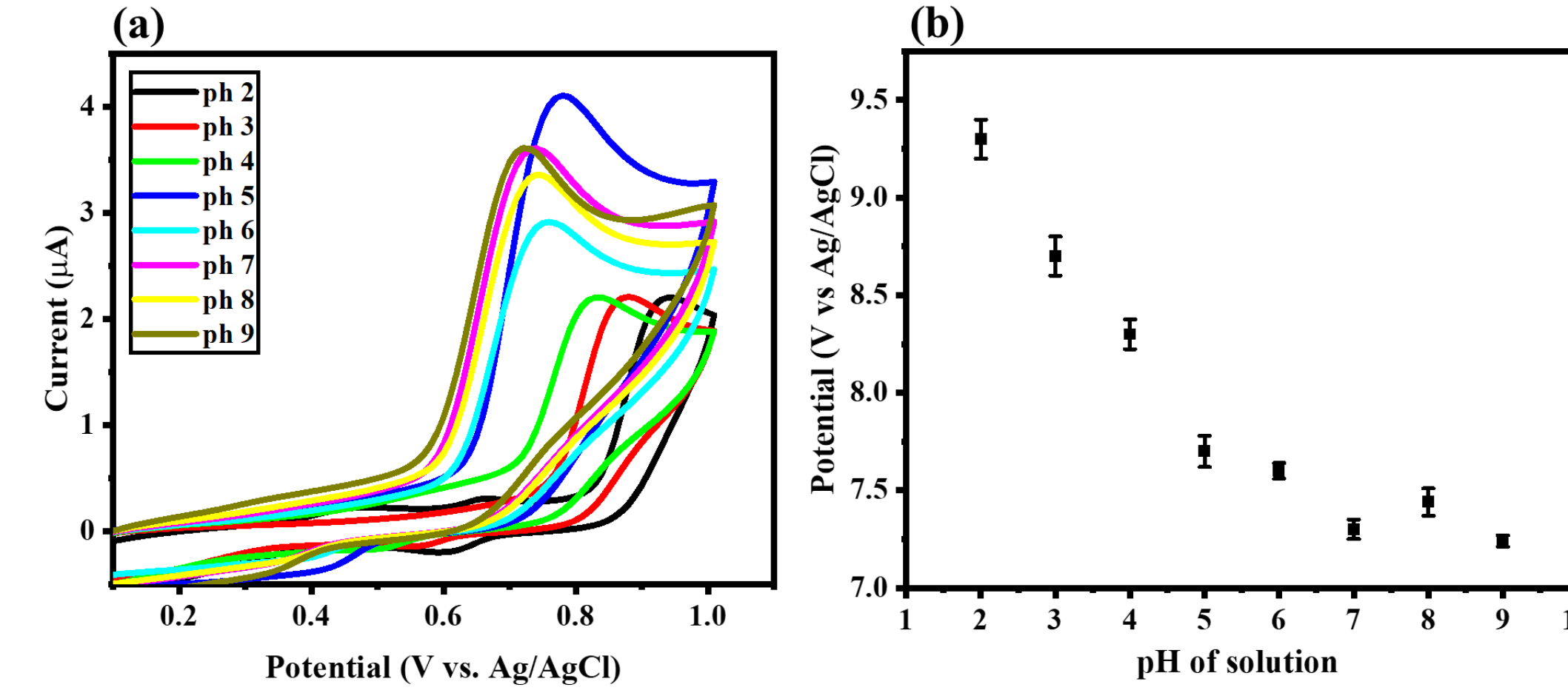


Fig. 8. Cyclic voltammograms on CNWO electrode recorded in phosphate buffer at different masses (a) and the graph of potential against pH of a solution (b).

DPV analysis

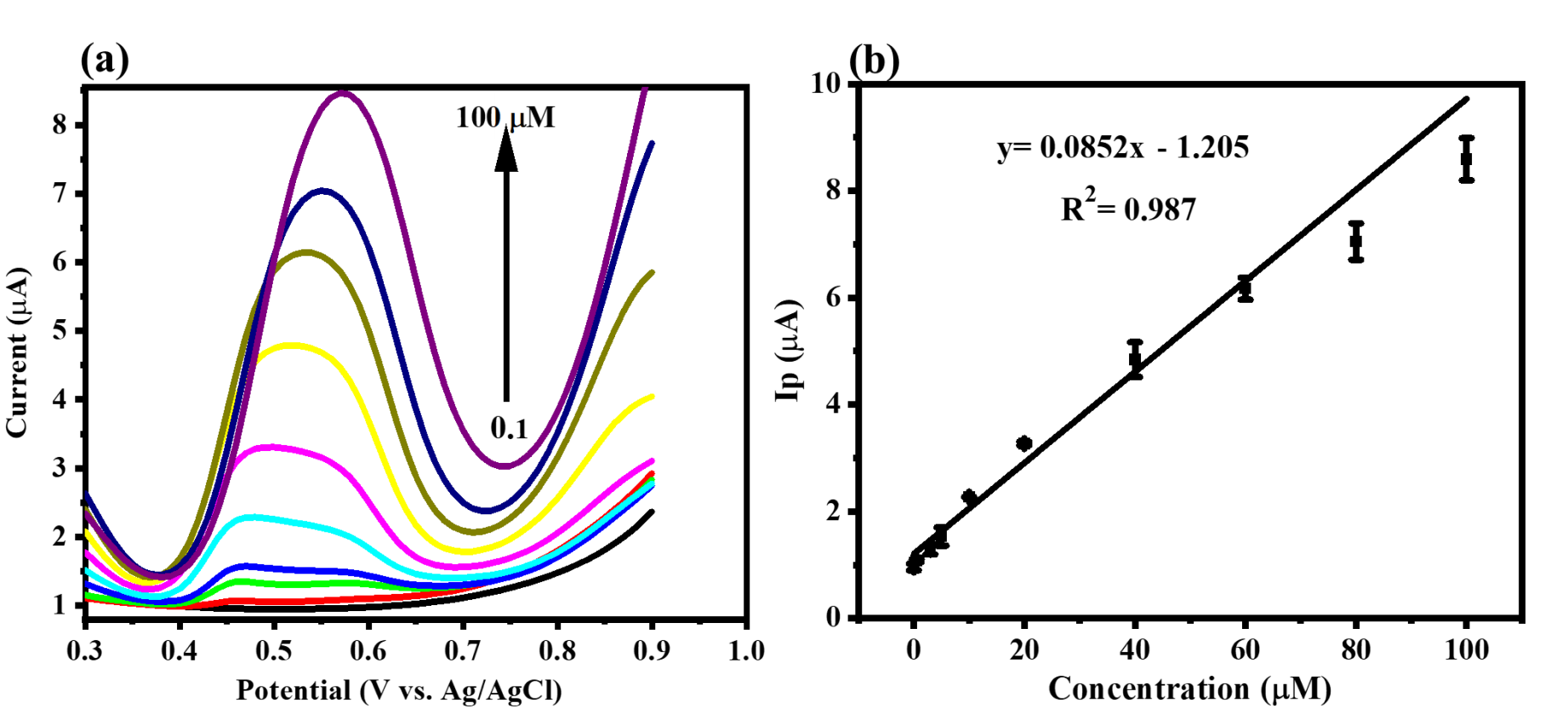


Fig. 9. Differential pulse voltammetry analysis of DFC at different concentrations on the CNWO modified electrode (a) and the corresponding plot of peak current against concentration (b).

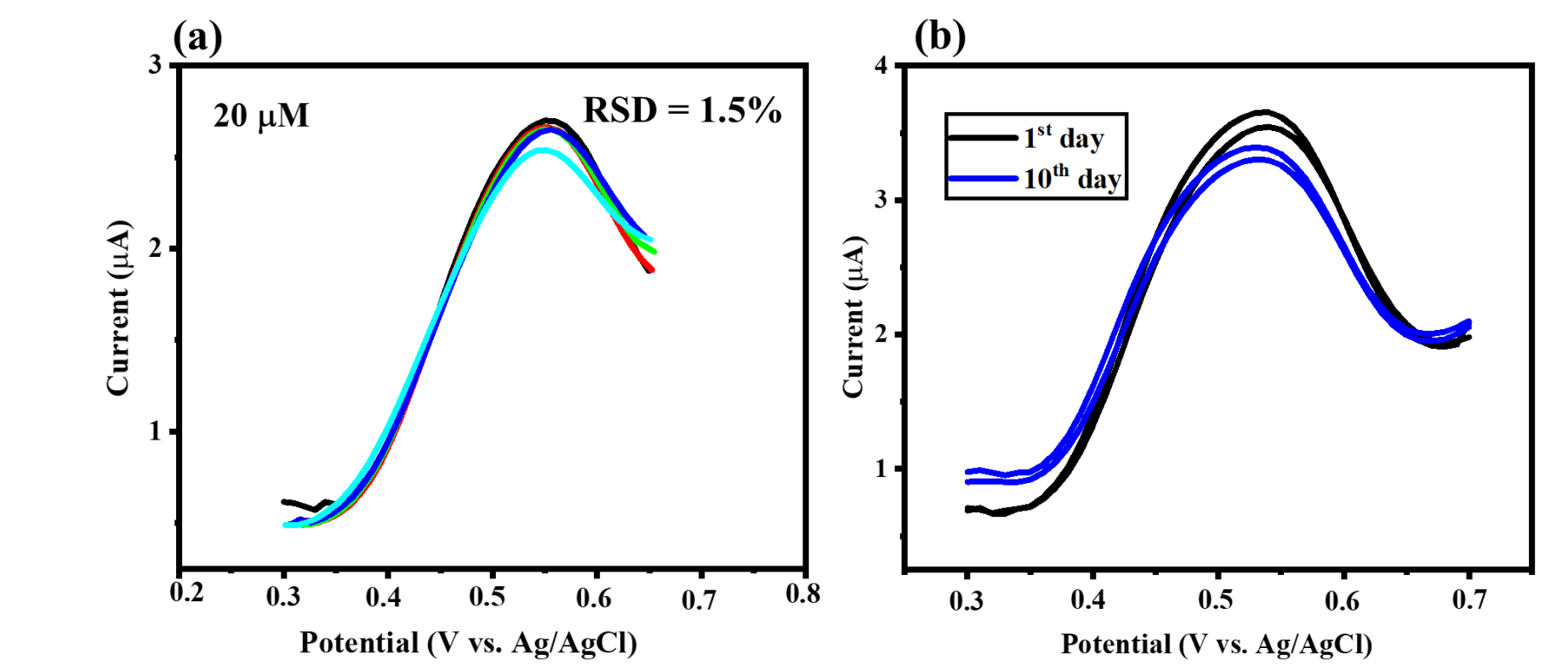


Fig. 10. DPV graphs of DFC showing stability and repeatability at 20 µM in one day (a) and stability for 20 µM of DFC for 10 days (b).

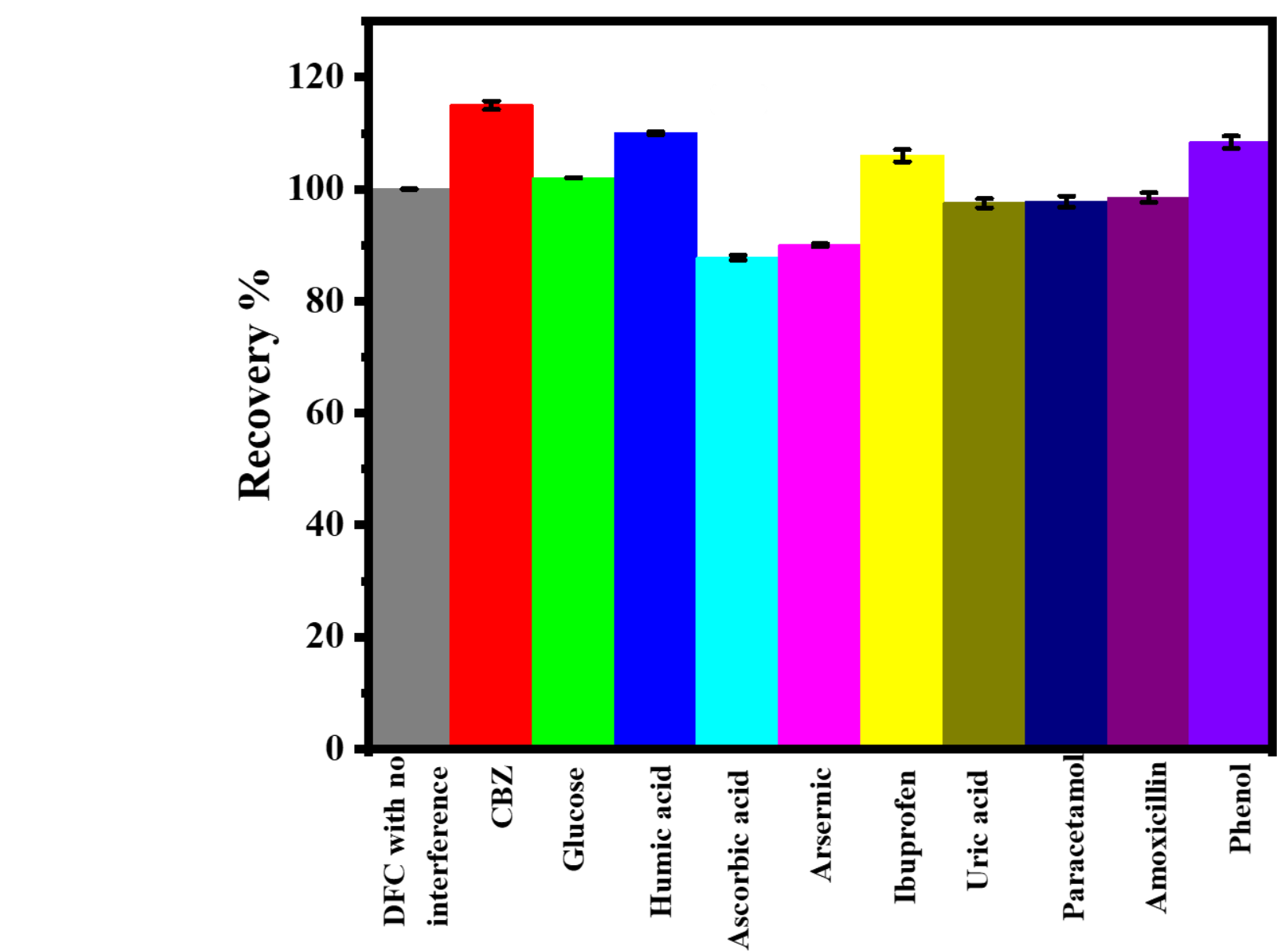


Fig. 11. The interferences of DFC detection on GC/CNWO electrode with other analytes.

Table 1: Summary of the recovery percentage of DFC in wastewater.

Added conc (µM)	Found Current (µA)	Recovery (%)	RSD (%)
5	0.629±0.0164	98.4	1.9
10	1.316±0.0218	97.4	1.7
20	2.351±0.0328	99.1	1.4

Conclusion

The sensor platform exhibited a detection limit of 0.114 µM and a sensitivity of 1.205 µA µM⁻¹ cm⁻² in the linear range of 0.1–100 µM. The recoveries in wastewater were not lower than 95%, confirming the potential application of the fabricated electrode for DFC detection in wastewater samples. Modifying a GC electrode with CNWO nanocomposites has proven to be a reliable and efficient method in sensor designs for monitoring DFC in water and wastewater.

References

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Acknowledgements

