Electroanalytical approach for quantification of pesticide maneb in river water sample using biochar-modified carbon paste electrode

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INTRODUCTION

Manganese derivative fungicide, maneb (MAN) has a potentially toxic effect on living organisms such as aquatic species and humans.[1]

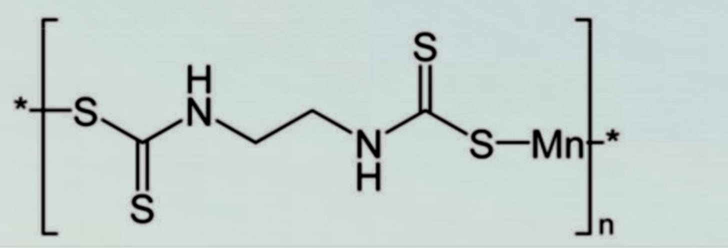

Fig. 1. Chemical structure of MAN

Biochar (BC) has good electrical conductivity with a characteristic catalytic effect and could be used as an electrode modifier for sensing pollutants in river water samples.[2]

The main objective of this study was to evaluate the possibilities of BC as a CPE modifier for the analysis of MAN in river water sample.

EXPERIMENTAL

The MAN analytical standard was dissolved in double distilled water.

Electrochemical measurements were carried out in a conventional three-electrode cell containing prepared BC-CPE (10 wt% of BC in CPE) as working electrode, a saturated calomel electrode (SCE) and platinum wire electrode as the reference and counter electrodes, respectively.

Voltammetric measurements were performed on AUTOLAB PGSTAT 12 electrochemical analyzer operated via GPES 4.9 software (Ecochemie, The Netherlands). BC was synthesized from the hardwood source *via* a pyrolysis process at 700 °C.

Britton-Robinson (B-R) buffer was used as supporting electrolyte.

RESULTS AND DISCUSSION

The good linearity of the calibration curve was obtained in the concentration range from 0.049 to 1.84 μg mL^{-1} of MAN with a limit of detection of 0.015 μg mL^{-1} MAN (Fig. 2) and a relative standard deviation (RSD) of 3.2%. Investigated interferences did not significantly affect the MAN signal intensity (Fig. 3).

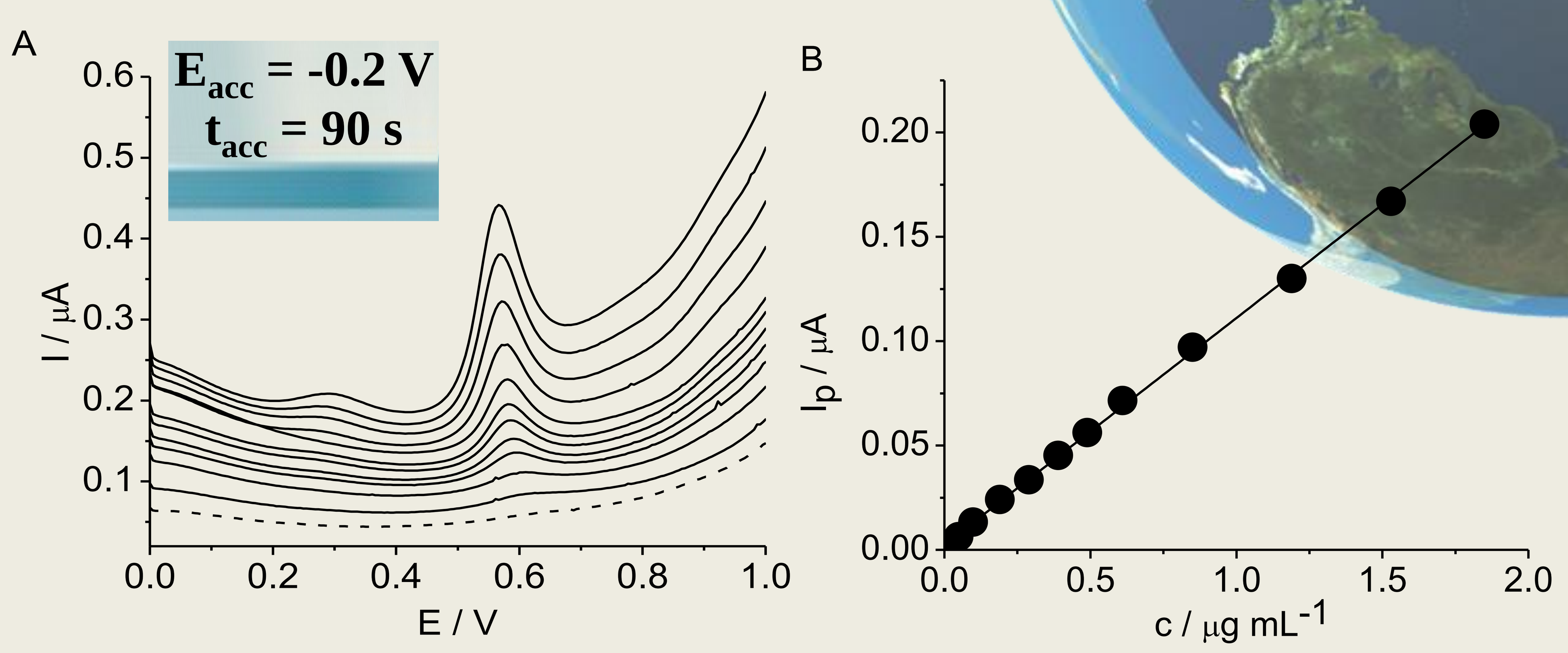

Fig. 2. DP-AdSV signals obtained for increasing concentrations of MAN (A) and the corresponding I_p vs c dependence (B) using BC-CPE. Supporting electrolyte: B-R buffer pH 7.0

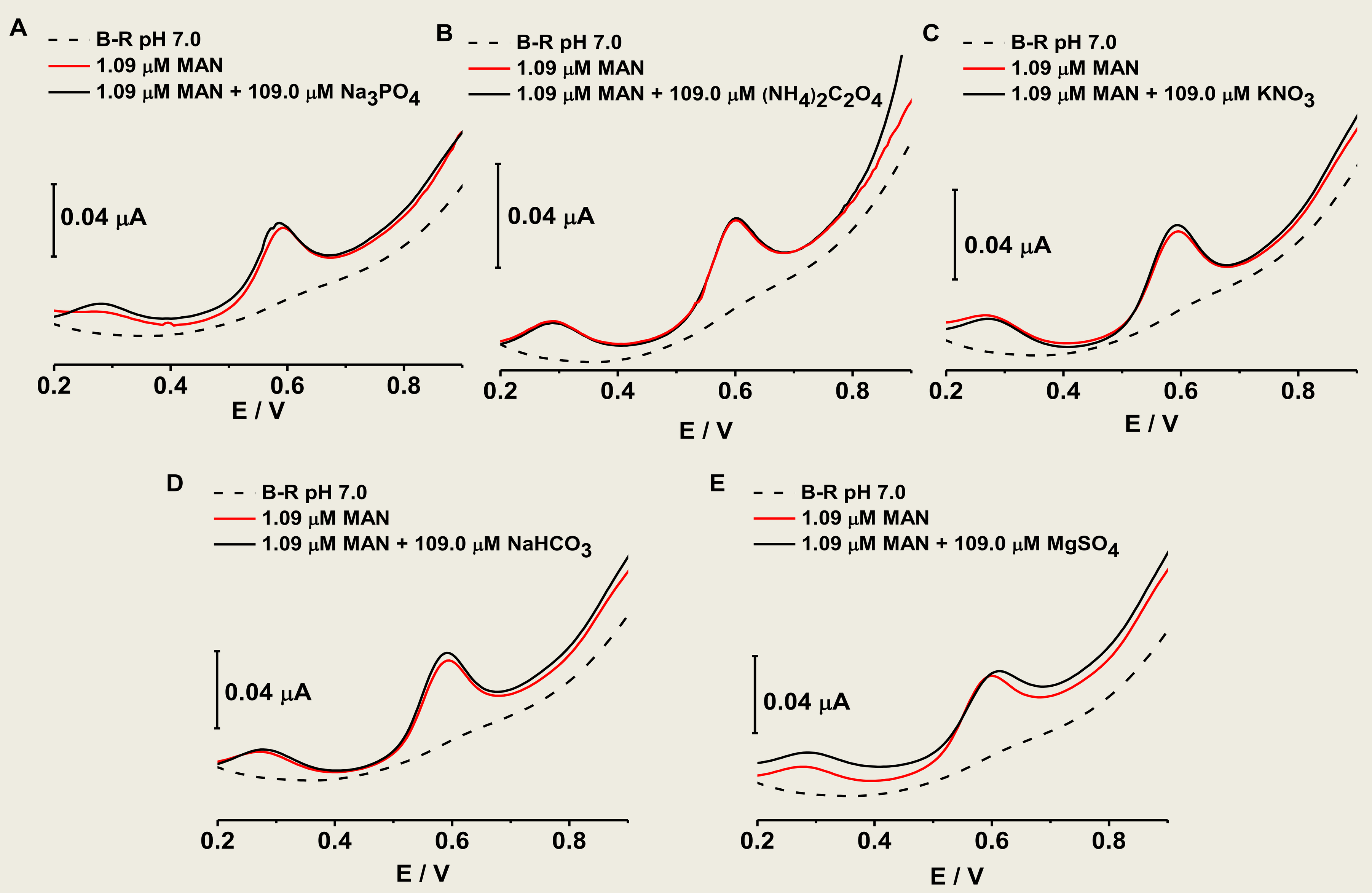

Fig. 3. DP-AdS voltammograms of 1.09 μmol L^{-1} MAN in the absence and presence of 100-fold excess of tested interferences: Na_3PO_4 (A) $(NH_4)_2C_2O_4$ (B), KNO_3 (C), $NaHCO_3$ (D), $MgSO_4$ (E) at pH 7.0 using BC-CPE

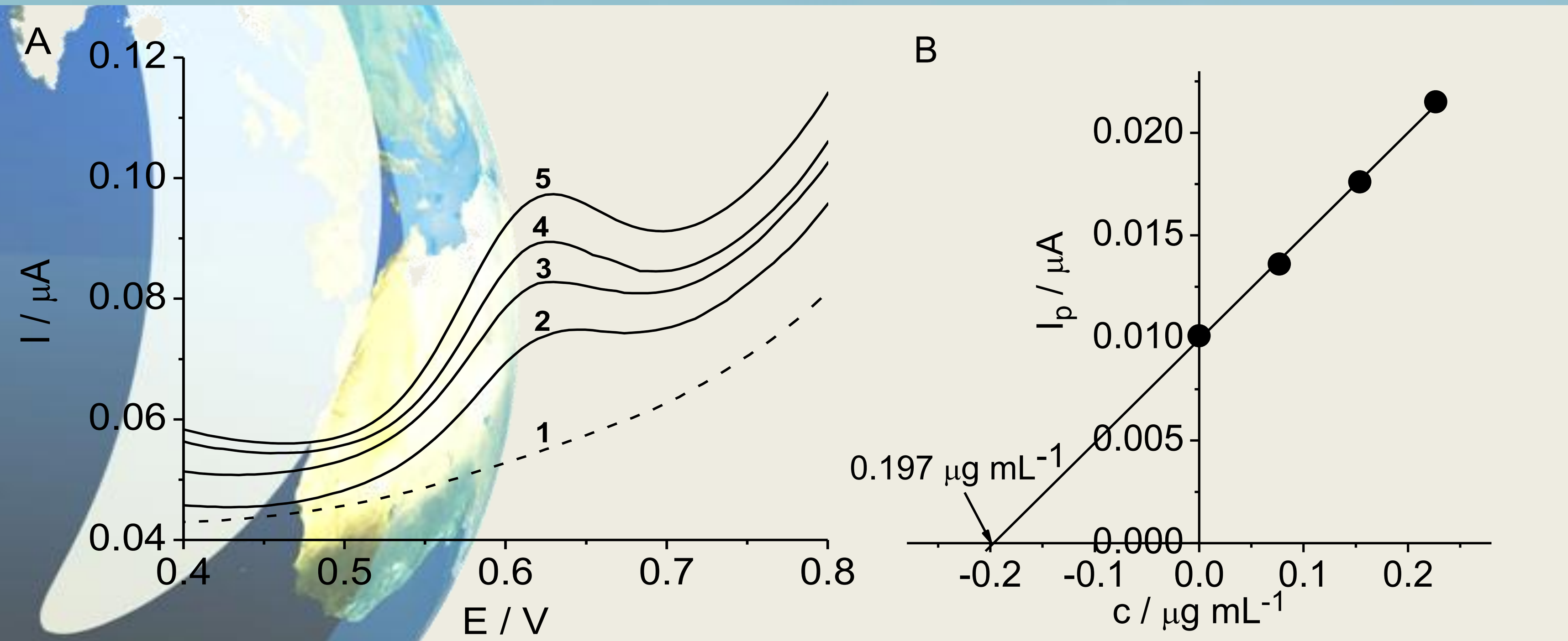

Fig. 4. DP-AdS voltammograms of MAN (A) determination in a river water sample at pH 7.0 using BC-CPE: (1) blank sample, (2) spiked sample with MAN, (3–5) standard additions. Corresponding analytical curve (B)

Table 1. Results for the DP-AdSV determination of MAN in spiked river water sample using BC-CPE

Parameters	Values
Added (μg mL^{-1})	0.198
Found[a] (μg mL^{-1})	0.197
Recovery[b] (%)	99.49
RSD (%)	1.02

[a]Average value of three replicate measurements.[b]Recovery = [(Found–Added)/Added] × 100 + 100%

CONCLUSION

- BC-modified CPE showed good selectivity for MAN sensing.
- The developed DP-AdSV method was successfully applied for MAN determination with good recovery for spiked river sample without sample treatments.

REFERENCES

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2. Akhil, D., Lakshmi, D., Kartik, A., Vo, D.-V. N., Arun, J., Gopinat, K. P., *Environ. Chem. Lett.* **2021**, 19, 2261-2297.

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