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Electrochemical Detection of Nucleobases Using a PEDOT-Modified Graphite Electrode

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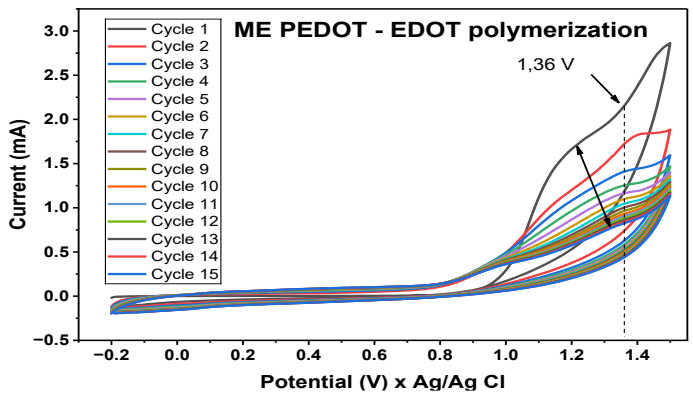
INTRODUCTION

Adenine, cytosine, guanine and thymine are the four nucleobases that encode genetic information, and their simultaneous determination is relevant to DNA analysis and damage assessment [1,2]. Direct electrochemical detection on bare carbon electrodes can be limited by weak or partially overlapping oxidation responses [2,3]. PEDOT is a conductive and electrochemically stable polymer that can improve interfacial charge transfer on carbon surfaces [4]. **Objective:** evaluate whether PEDOT electrodeposited on graphite improves the individual and simultaneous electrochemical detection of the four nucleobases. The modified surface was characterized by Raman spectroscopy and AFM, and analytical performance was assessed by CV and chronoamperometry.

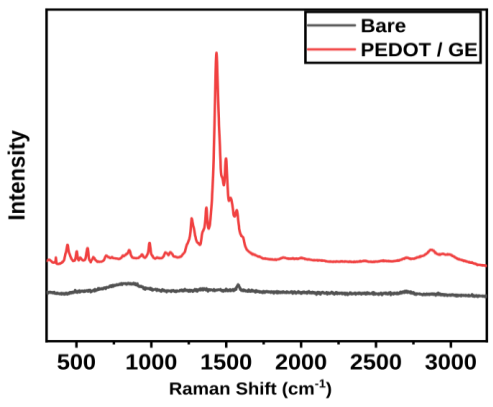
RESULTS AND DISCUSSION

PEDOT modification changes the graphite surface morphologyand electrochemical response, improving the sensitivity and enabling individual and simultaneous detection of the four nucleobases.

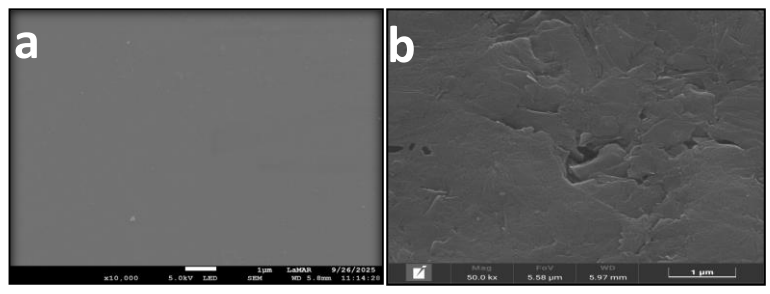
1. PEDOT electrodeposition



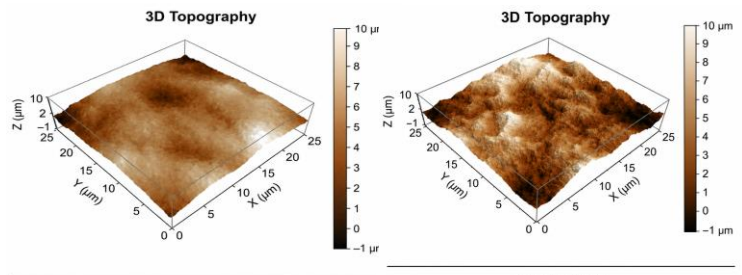
2. Raman characterization



3. SEM images of (a) bare electrode and (b) PPDA-modified electrode.



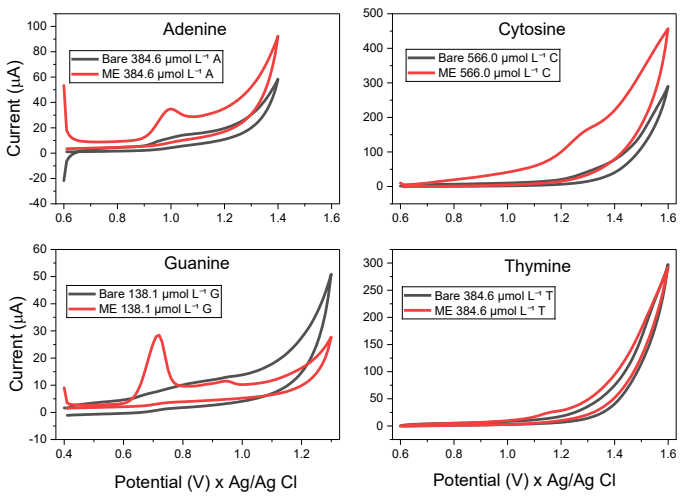
4. AFM topography



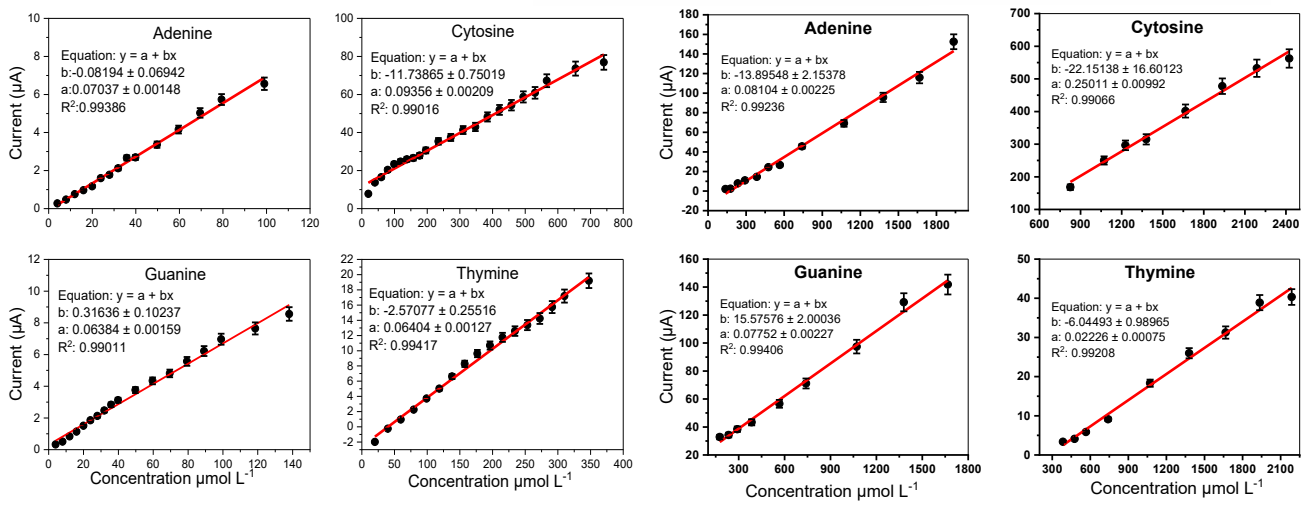
Parameter Block	
Area	25 x 25 µm²
Ra (Average Roughness)	0.45 µm
Rz (Mean Peak-to-Valley Height)	1.903 µm

Parameter Block	
Area	25 x 25 µm²
Ra (Average Roughness)	3.08 µm
Rz (Mean Peak-to-Valley Height)	9.58 µm

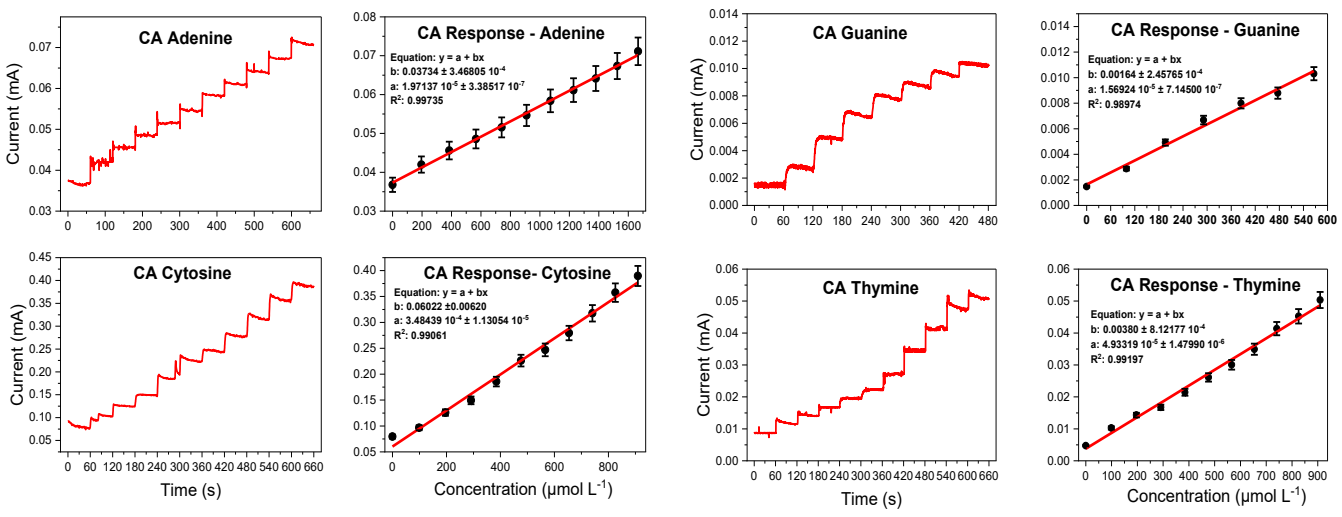
5. Individual nucleobase responses (CV)



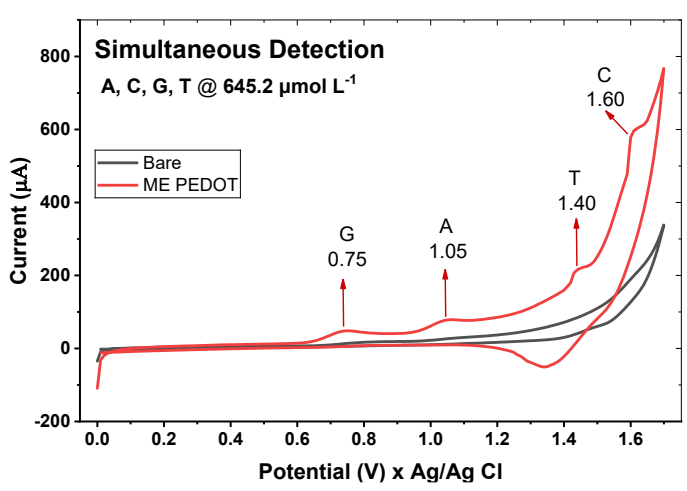
6. CV calibration response



7. Chronoamperometry



8 Simultaneous detection of nucleobases



ANALYTICAL PERFORMANCE

Analyte	Range (µmol L^{-1})	Potential (V)	LOD (µmol L^{-1})	LOQ (µmol L^{-1})	RSD (%)
Adenine	0–1935	1.05	7.6	25.4	1.49
Cytosine	0–2424	1.59	8.4	27.9	1.00
Guanine	0–1667	0.75	4.6	15.4	1.82
Thymine	0–2187	1.40	15.9	52.9	1.76

CONCLUSIONS

- PEDOT modification enhanced the electrochemical response of the graphite electrode toward adenine, cytosine, guanine, and thymine, providing concentration-dependent signals over broad analytical ranges.
- The modified electrode also enabled the four nucleobases to be distinguished in simultaneous measurements through their characteristic oxidation responses.
- The low RSD values and micromolar detection limits demonstrate satisfactory analytical reproducibility and sensitivity.
- PEDOT-modified graphite shows promise as a simple and accessible platform for individual and multi-analyte electrochemical detection of nucleobases.

REFERENCES AND ACKNOWLEDGMENTS

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