Electronic Supplementary Material (ESI) for RSC Advances.


# Supplementary material

## Chronoampermetric Enzymatic Glucose Sensor Based on Doped Polyindole /Multi-walled Carbon Nanotube Composites Modified onto Screen-Printed Carbon Electrode as Portable Sensing Device for Diabetes

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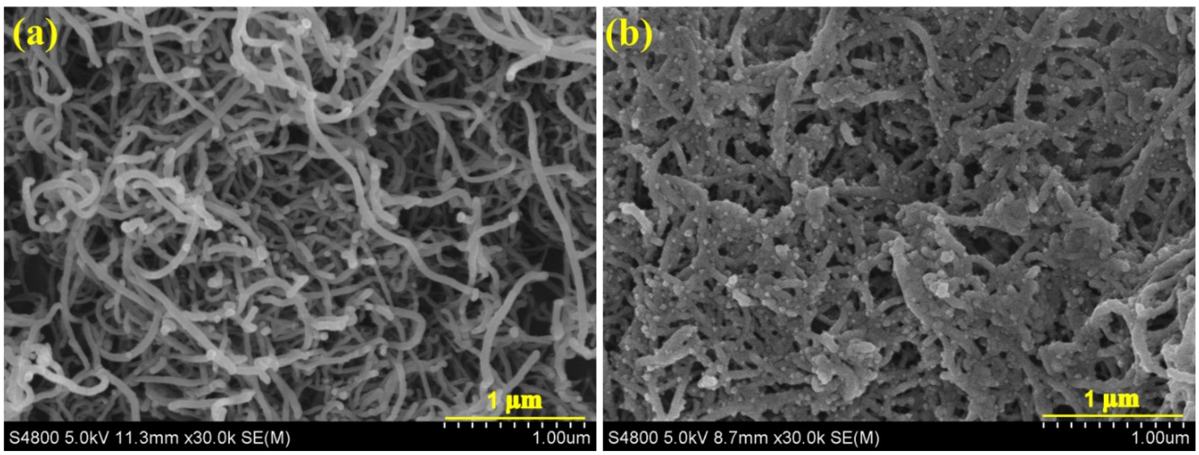



**Fig. S1** Surface morphologies at the 30,000x magnification of: (a) MWCNT; and (b) 1.5%MWCNT-dPIn.

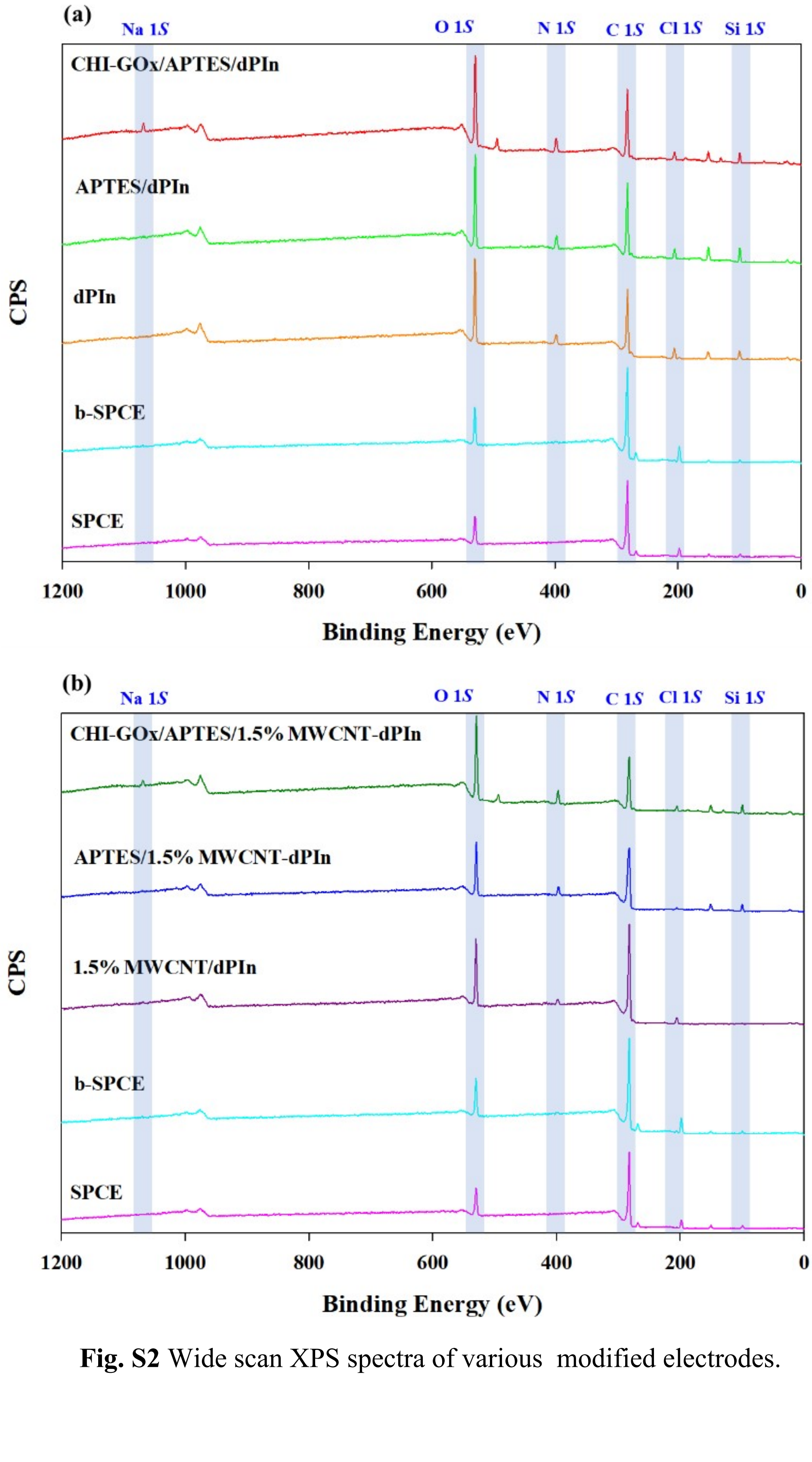
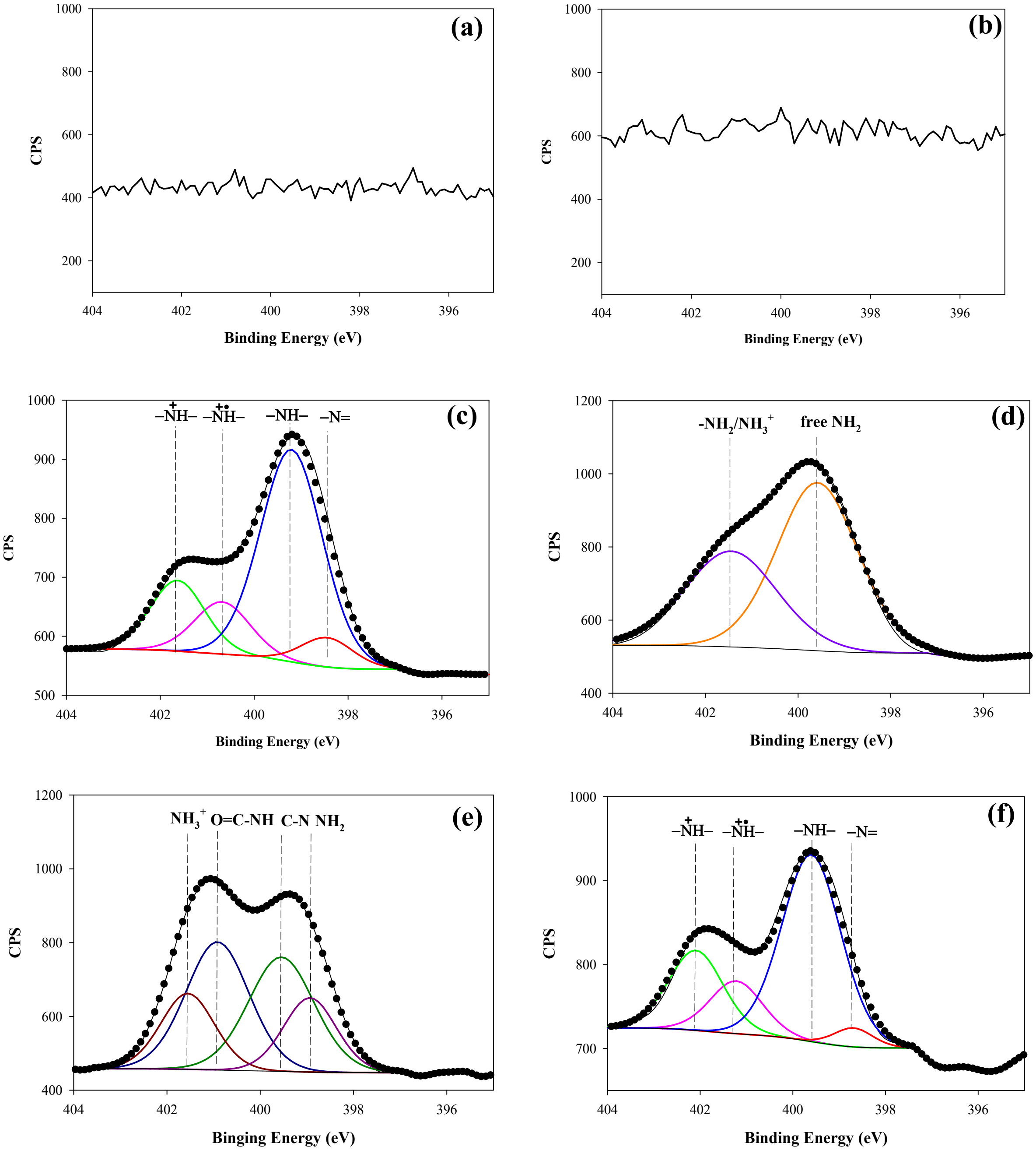



**Fig. S2** Wide scan XPS spectra of various modified electrodes.


(a)
CPS
Binding Energy (eV)
(b)
CPS
Binding Energy (eV)
(c)
–N̈H–
–NH–
–N=
CPS
Binding Energy (eV)
(d)
-NH2/NH3+
free NH2
CPS
Binding Energy (eV)
(e)
NH3+ O=C-NH C-N NH2
CPS
Binging Energy (eV)
(f)
–NH–
–N=
CPS
Binding Energy (eV)

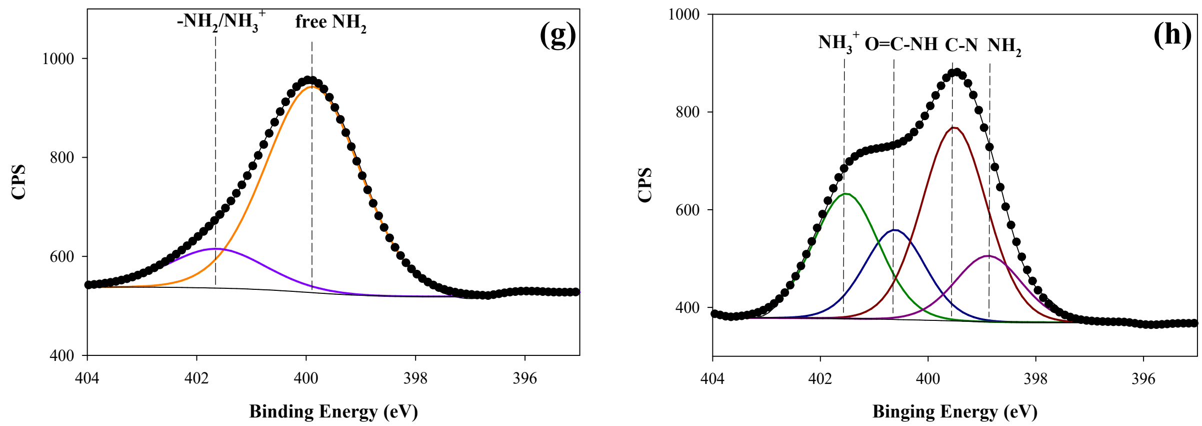



**Figure S3** High-resolution spectra of N 1s of (a) SPCE; (b) b-SPCE; (c) dPIn; (d) APTES/dPIn; (e) CHI-GOx/ APTES/dPIn; (f) 1.5% MWCNT-dPIn; (g) APTES/1.5% MWCNT-dPIn; and (h) CHI-GOx/1.5% MWCNT-dPIn.

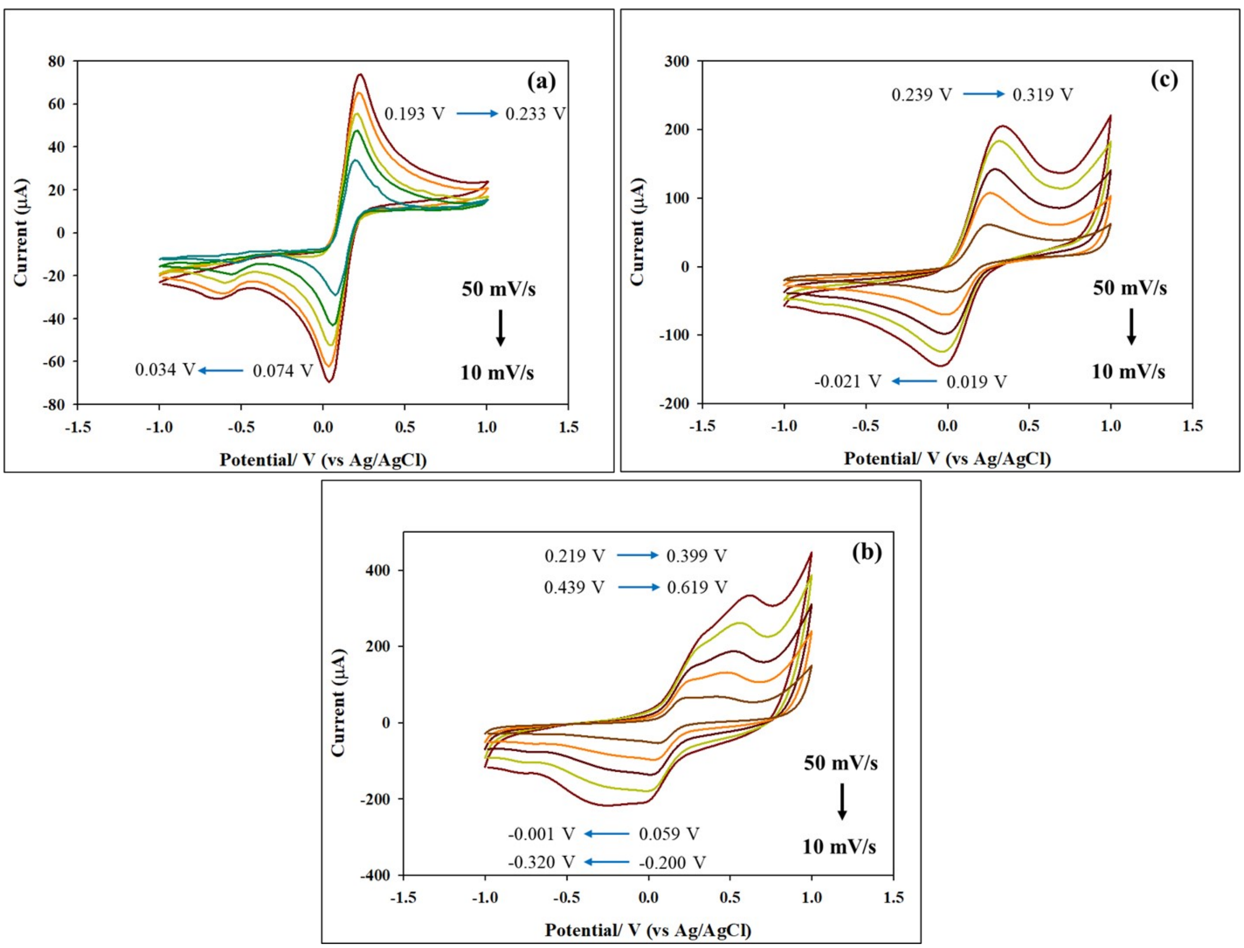



**Fig. S4** Cyclic voltammograms of the modified electrodes in a solution of 5 mM of $K_3[Fe(CN_6)]/K_4[Fe(CN_6)]$ containing 0.1 M PBS solution (pH 7.4) and 0.1 M KCl: (a) SPCE; (b) dPIn; and (c) 1.5%MWCNT-dPIn.

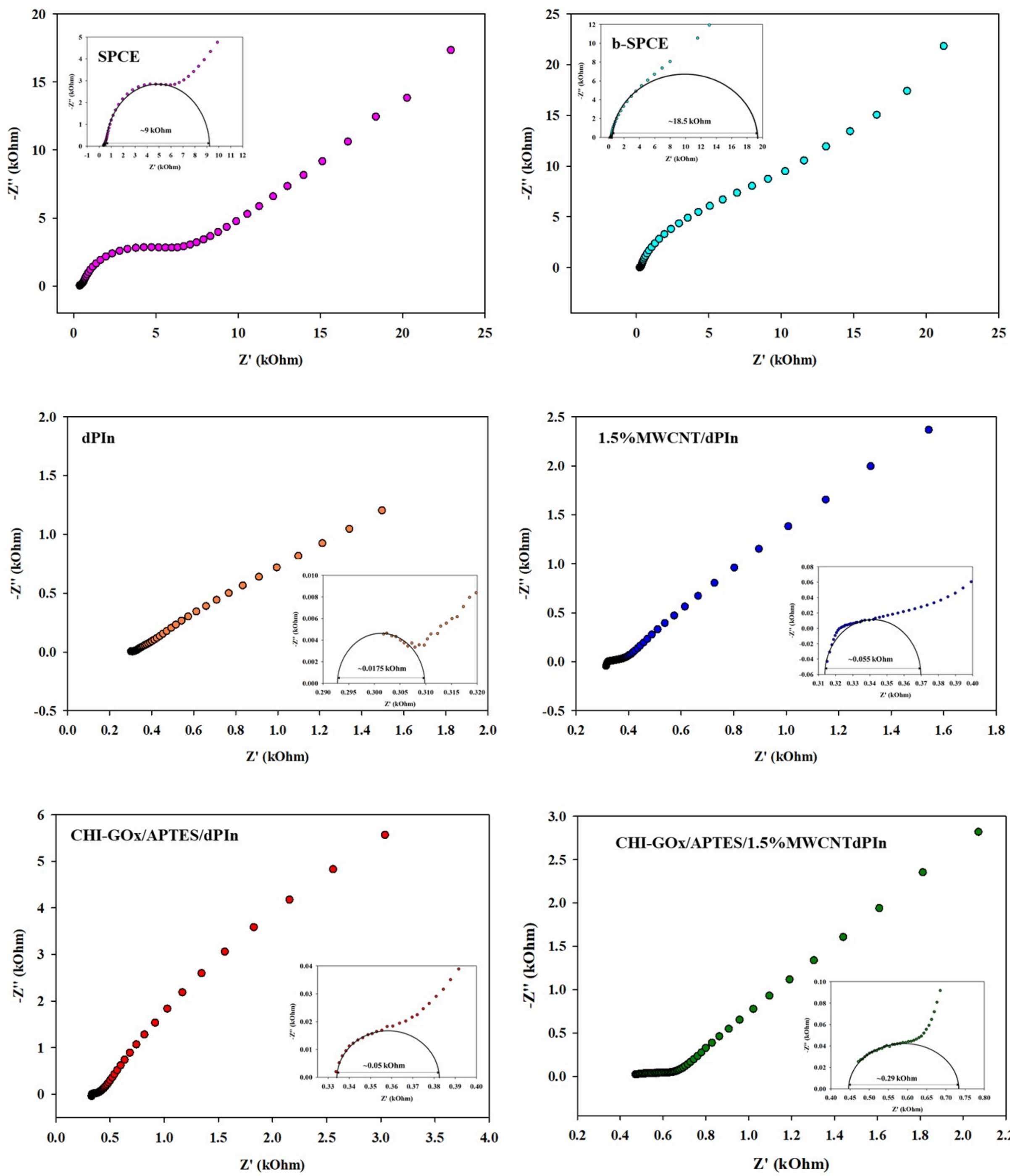



**Fig. S5** Nyquist plots of various modified electrodes in a solution of 5 mM of $K_3[Fe(CN_6)]/K_4[Fe(CN_6)]$ containing 0.1 M PBS solution (pH 7.4) and 0.1 M KCl.

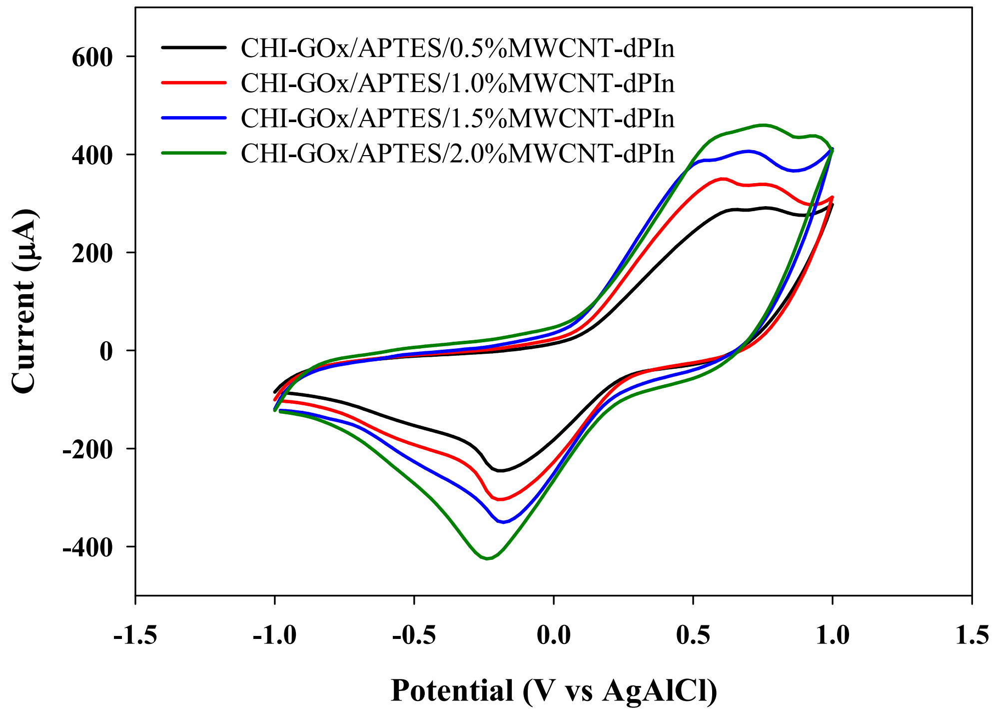



**Fig. S6** Cyclic voltammograms of CHI-GOx immobilized on various APTES/MWCNTs-dPIn electrodes in a solution of 5 mM of $K_3[Fe(CN_6)]/K_4[Fe(CN_6)]$ containing 0.1 M PBS solution (pH 7.4) and 0.1 M KCl.

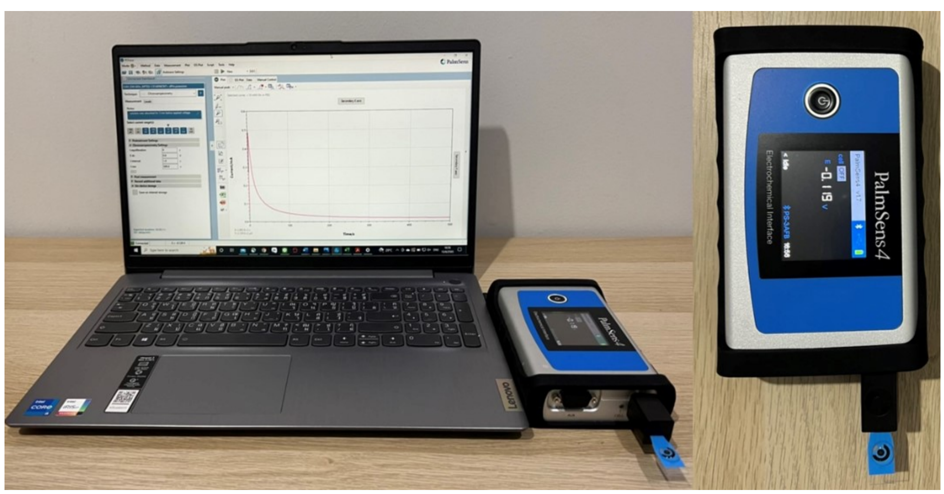



**Fig. S7** Experimental setup of the portable enzymatic glucose sensor by chronoamperomatic detection in glucose solution by Palmsens4 device connected with the modified electrode and linked to a laptop computer via Bluetooth or USB connector.

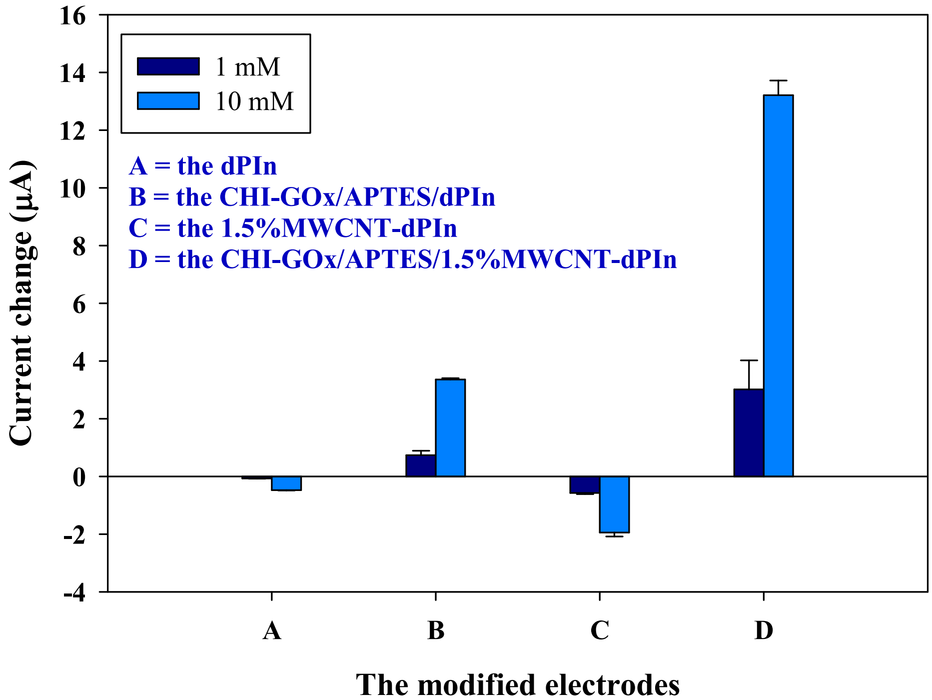



**Fig. S8** Current changes ($\Delta I = I_{glc}-I_{PBS}$) at +0.6 V vs. Ag/AgCl in 1 mM and 10 mM glucose solutions of various modified electrodes.

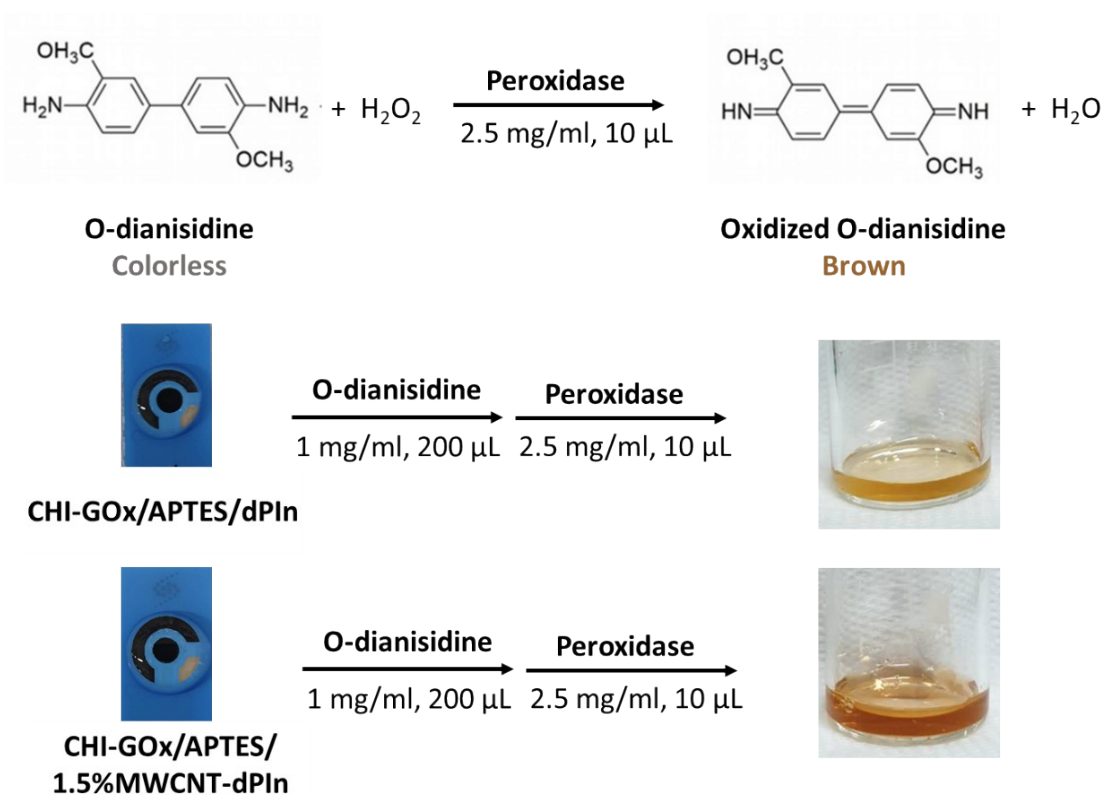



**Fig. S9** Determination of $H_2O_2$ produced in glucose oxidation of the fabricated glucose sensors.

First, 200 µL of 1 mM glucose solution was dropped on the modified electrodes, CHI-GOx/APTES/dPIn and CHI-GOx/APTES/1.5%MWCNT-dPIn, the reaction time was 10 min. Then, the glucose solution reacted with 200 µL of o-dianisidine (1 mg/ml in 1 mL ethanol:49 mL 0.1 M PBS). Finally, 10 µL of the enzyme peroxidase (2.5 mg/ml) in 0.1 M PBS was dropped into the mixture solution. The color of the mixture solution suddenly changed from colorless to brown as shown in **Fig. S6**. This result confirms that $H_2O_2$ was generated by the interaction of glucose and GOx.

**Calculations of sensitivity for CHI-GOx/APTES/dPIn and CHI-GOx/APTES/1.5%MWCNT- dPIn**

1) The power law equation of the CHI-GOx/APTES/dPIn is $y = 0.8312x^{0.5251}$, $r^2 = 0.9805$, where y is the current change (ΔI) and x is the glucose concentration.

Thus, the power law equation is $\Delta I = 0.8312C^{0.5251}$

$\Delta I = 0.8312 \cdot C^{0.5251}$

$$\frac{d(\Delta I)}{dC} = \frac{0.8312\, dC^{0.5251}}{dC}$$

$$\frac{d(\Delta I)}{dC} = 0.8312 \cdot 0.52517 C^{(0.5251-1)}$$

At LOD, C = 0.01 mM, $\frac{d(\Delta I)}{dC}$ = 3.9 µA/mM

The sensitivity was calculated from the slope (3.9 µA/mM) divided by the geometric surface area (0.07 $cm^2$). Thus, the sensitivity of the glucose sensor based on CHI-GOx/APTES/dPIn is 55.7 µA/mM·$cm^2$.

2) The power law equation of the CHI-GOx/APTES/1.5%MWCNT- dPIn is $y = 3.0722x^{0.5667}$, $r^2 = 0.9927$, where y is the current change (ΔI) and x is the glucose concentration.

Thus, the power law equation is $\Delta I = 3.0722C^{0.5667}$

$\Delta I = 3.0722 \cdot C^{0.5667}$

$$\frac{d(\Delta I)}{dC} = \frac{3.0722\ dC^{0.5667}}{dC}$$

$$\frac{d(\Delta I)}{dC} = 3.0722 \cdot 0.5667C^{(0.5667-1)}$$

At LOD, C = 0.01 mM, $\frac{d(\Delta I)}{dC}$ = 12.8 μA/mM

The sensitivity was calculated from the slope (12.8 μA/mM) divided by the geometric surface area (0.07 $cm^2$). Thus, the sensitivity of the glucose sensor based on CHI-GOx/APTES/1.5%MWCNT- dPIn is 182.9 μA/mM·$cm^2$.