

A novel wireless paper-based potentiometric platform for monitoring glucose in blood

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Electronic Supplementary Information (ESI)

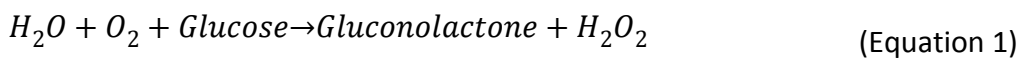
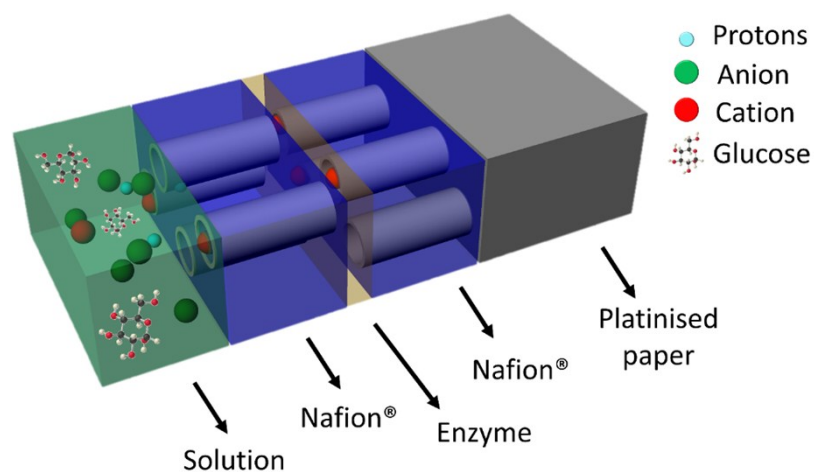


Fig. S1. Enzymatic paper-based working electrode with the corresponding enzymatic layer of glucose oxidase (GOx) between two layers of Nafion.

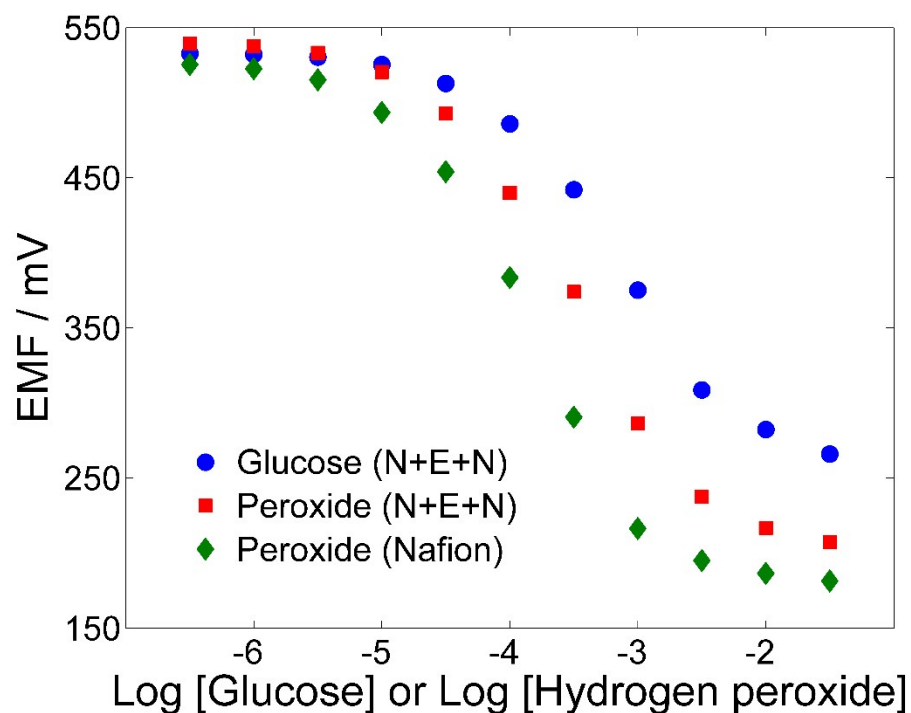


Fig. S2. Comparison of the potentiometric response under different conditions. Blue dots: enzymatic sensor (Nafion//Enzyme//Nafion//Pt) with addition of glucose; Red squares: same enzymatic sensor, but no glucose and direct addition of hydrogen peroxide; Green diamonds: response of a Nafion-coated platinum electrode (i.e., no enzyme) with addition of hydrogen peroxide.

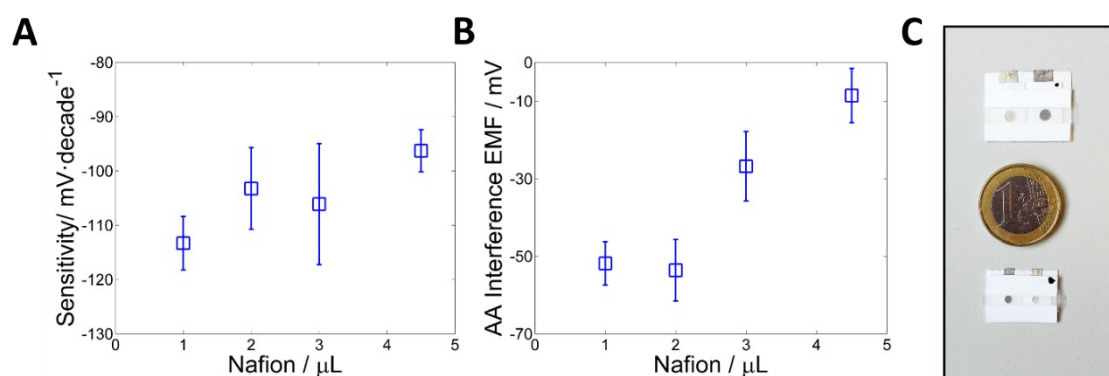


Fig. S3. (A) Sensitivity of the working electrode versus the amount of Nafion layer and (B) response to the main interferent ascorbic acid (AA) versus amount of the Nafion layer (1, 2, 3 and 4.5 μL). (C) Picture of the comparison in size of the devices with 3 mm (top) and 2 mm (bottom) diameter.

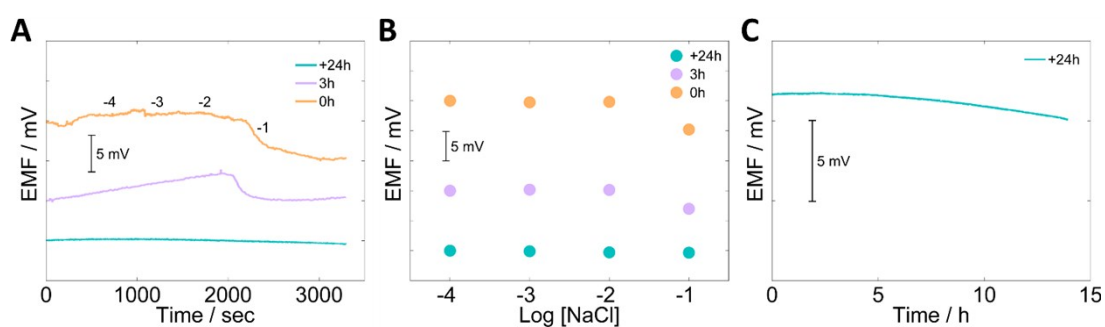


Fig. S4. Comparison between three different conditioning step of reference electrodes. (A) Time trace, (B) calibration plot -under three different conditions of conditioning: more than 24 hours, only 3 hours and no conditioning- and (C) long term stability study for used references electrodes.

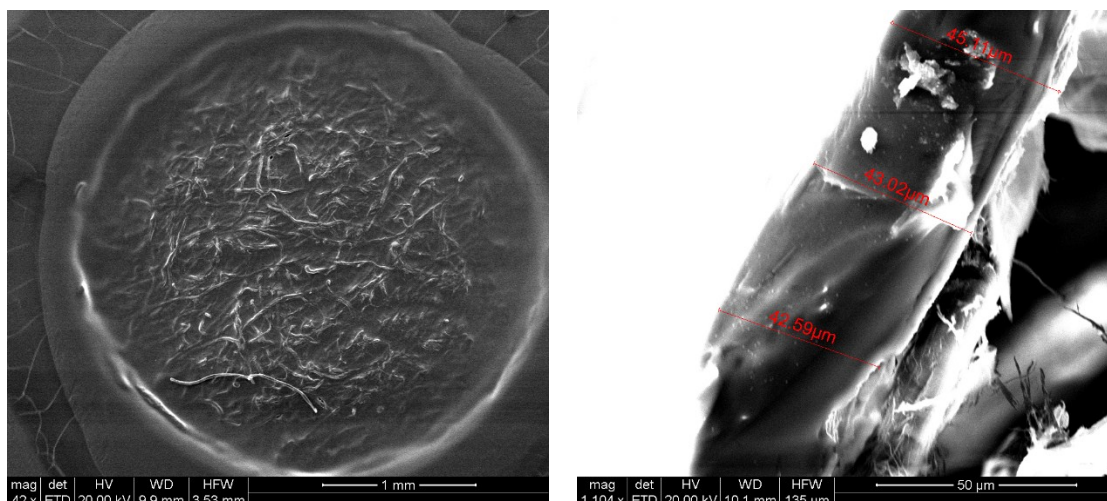


Fig. S5. Electron microscope images of a Nafion membrane drop cast on top of an electrode and thickness of the layer. Left: top view. Right: cut view to show the approximate thickness.

Table S1 Optimization of Nafion layers in paper-based electrodes.

3 mm Electrodes	Nafion + Enzyme + Nafion (μL)	2 mm Electrodes	Nafion + Enzyme + Nafion (μL)
Condition A	2 + 7.5 + 2	Condition a	1 + 5 + 1
Condition B	4.5 + 7.5 + 4.5	Condition b	2 + 5 + 2
Condition C	7 + 10 + 7	Condition c	3 + 5 + 3
Condition D	9 + 10 + 9	Condition d	4.5 + 5 + 4.5

Table S2 Comparison between concentrations: Potentiometry method vs. Hospital provided values of glucose in 10 real serum samples.

Potentiometry [Glucose] / mM	H-6-G-PD Hospital	Recovery / %
9.8 ± 1.4	9.5	103.6
4.8 ± 0.8	4.4	109.2
3.7 ± 0.2	3.6	102.5
5.6 ± 0.3	5.7	97.7
4.9 ± 0.3	4.7	104.3
4.5 ± 0.5	4.8	94.5
4.4 ± 0.3	4.9	89.1
4.8 ± 0.3	4.9	96.1
8.5 ± 1.3	8.4	101.1
4.8 ± 0.3	4.4	108.6

Table S3 Comparison of glucose levels : Potentiometry Vs. Glucometer in six real serum samples and three real blood samples.

Potentiometry [Glucose] / mM	Glucometer	Recovery / %
Blood: 4.5	4.8	94.2
Blood: 5.2	5.0	104.8
Blood: 5.5	5.8	94.9
Serum: 3.4	3.2	108.4
Serum: 4.4	4.2	105.4
Serum: 4.4	4.7	93.3
Serum: 14.9	15.8	93.9
Serum: 10.3	12.1	85.4
Serum: 17.9	18.7	95.9

Table S4 Total cost of making these electrodes in the lab based on platinized paper, GOx and Nafion .

Working electrode - Material (including service)	Price in euros (€)
3 Platinum paper (technician+process+room)→ 76 electrodes +(15€/100 filters)	$(145€/3+0.15)/76 = 0.64$
Glucose Oxidase ((0.3 gr/0.002 gr) x 10)=1500 electrodes)	$169€/1500 = 0.11$
Nafion® solution (25 mL/0.014 mL=1785.7 electrodes)	$115€/1785.7 = 0.06$
SubTotal	0.81 €/electrode
Reference electrode - Material (including service)	Price in euros (€)
Ag/AgCl paper ((200€ Ag/AgCl ink)/30 filter paper)+(15€/100 filters)	$(6.6*+0.15)/76 = 0.09$
*(price depends on the market price of silver)	
PVB membrane (39€/100g)→(0.078g/10 electrodes)	$0.39 \times 0.0078 = 0.003$
SubTotal	0.093 €/electrode
Sampling cell - Material	Price in euros (€)
Plastic mask (roll of 10x0.15m)	$500€/5000 = 0.1$
Hydrophilic plastic	$350€/6000 = 0.05$
SubTotal	0.15 €/ cell
Total	1.05 €/ device