

A novel glucose sensor using lutetium phthalocyanine as redox mediator in reduced graphene oxide conducting polymer multifunctional hydrogel

AL-SAGUR, H, KOMATHI, S, KHAN, M, GUREK, A G and HASSAN, Aseel
<<http://orcid.org/0000-0002-7891-8087>>

Available from Sheffield Hallam University Research Archive (SHURA) at:

<http://shura.shu.ac.uk/14112/>

This document is the author deposited version. You are advised to consult the publisher's version if you wish to cite from it.

Published version

AL-SAGUR, H, KOMATHI, S, KHAN, M, GUREK, A G and HASSAN, Aseel (2017). A novel glucose sensor using lutetium phthalocyanine as redox mediator in reduced graphene oxide conducting polymer multifunctional hydrogel. *Biosensors & bioelectronics*, 92, 638-645.

Copyright and re-use policy

See <http://shura.shu.ac.uk/information.html>

A novel glucose sensor using lutetium phthalocyanine as redox mediator in reduced graphene oxide conducting polymer multifunctional hydrogel

H. Al-Sagur^{1†}, S. Komathi^{1†}, M. A. Khan², A.G Gurek³ and A. Hassan^{1}*

¹*Materials and Engineering Research Institute, Sheffield Hallam University, Sheffield, UK*

²*Biomedical Research Institute, Sheffield Hallam University, Sheffield, UK*

³*Gebze Technical University, Department of Chemistry, Gebze 41400, Kocaeli, Turkey*

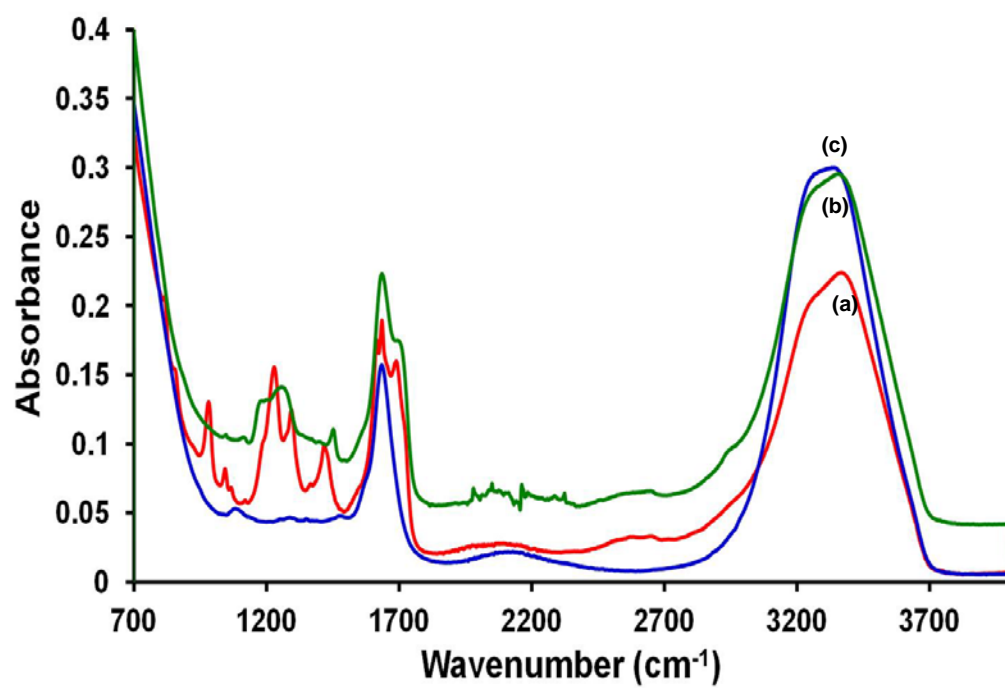
*† authors contributed equally, * corresponding author*

Supporting Information (SI)

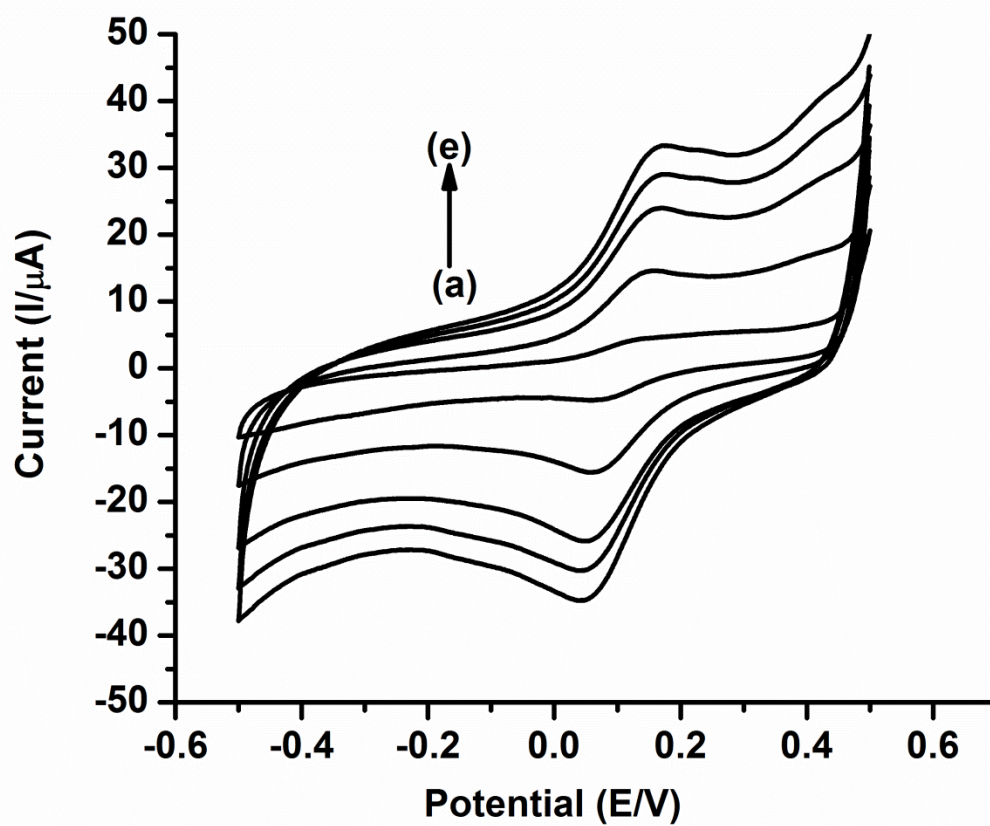
SI-1**Table 1. UV-Visible absorption data for MFH and LuPc₂ thin films**

Sample	N (nm)	B (nm)	Benzenoid to quinoid transitions (nm)	π-radical (nm)	Q (nm)	RV (nm)
LuPc ₂	317	390	-	543	706	938
PAA-rGO/VS- PANI/LuPc ₂	-	342	430	546	712	-
PAA/VS-PANI/LuPc ₂	-	356	432	543	702	-
PAA-rGO/LuPc ₂	-	385	-	559	718	-

SI-2

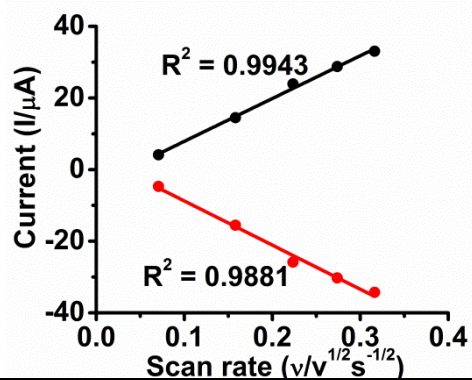


FTIR spectra of (a) PAA-rGO/VS-PANI/LuPc₂-MFH, (b) PAA/VS-PANI/LuPc₂-MFH, (c) PAA-rGO/LuPc₂-MFH.

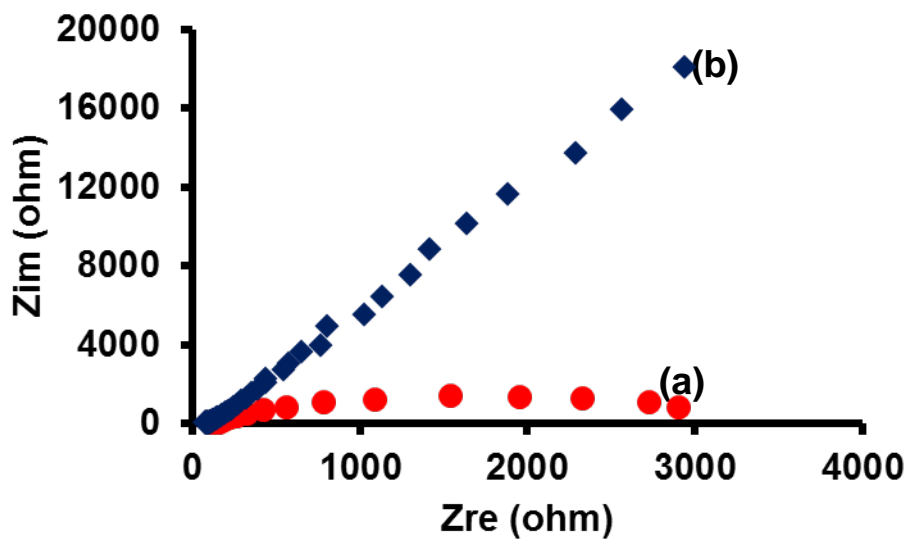


Cyclic voltammograms (CVs) of PAA-rGO/Vs-PANI/LuPc₂/GOx-MFH in 5 mM of Fe(CN)₆^{3-/4-} containing 0.1 M NaCl for different scan rates (a–e); 5–100 mVs⁻¹; (Inset)

Dependence of peak current on scan rates.

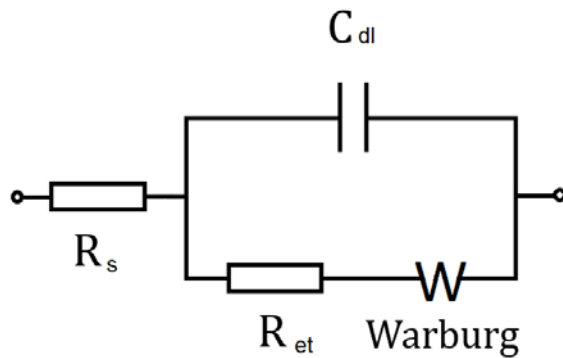


SI-4A



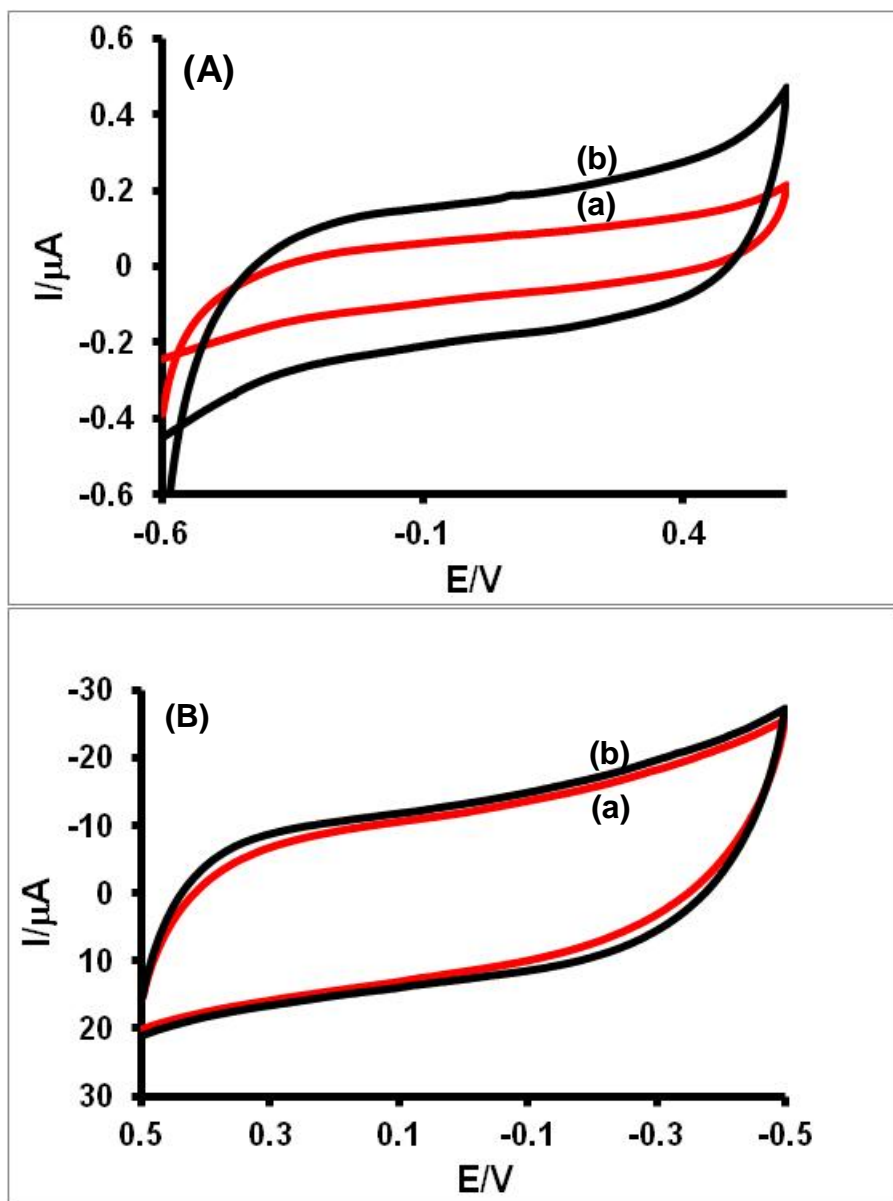
Nyquist plots (Z_{im} vs. Z_{re}) of PAA-rGO/VS-PANI/LuPc₂/GOx-MFH (a) and PAA/VS-PANI/LuPc₂/GOx-MFH (b) in the presence of PBS containing 0.1M NaCl

SI-4B



Equivalent circuit model for the fabricated biosensor where R_s : the uncompensated solution resistance; R_{et} is the electron transfer resistance; Warburg diffusion element (W) and C_{dl} is the double layer capacitance. Based on the model, good agreement was achieved over the frequency range 10 Hz and 2MHz between the simulated and experimental results

SI-5



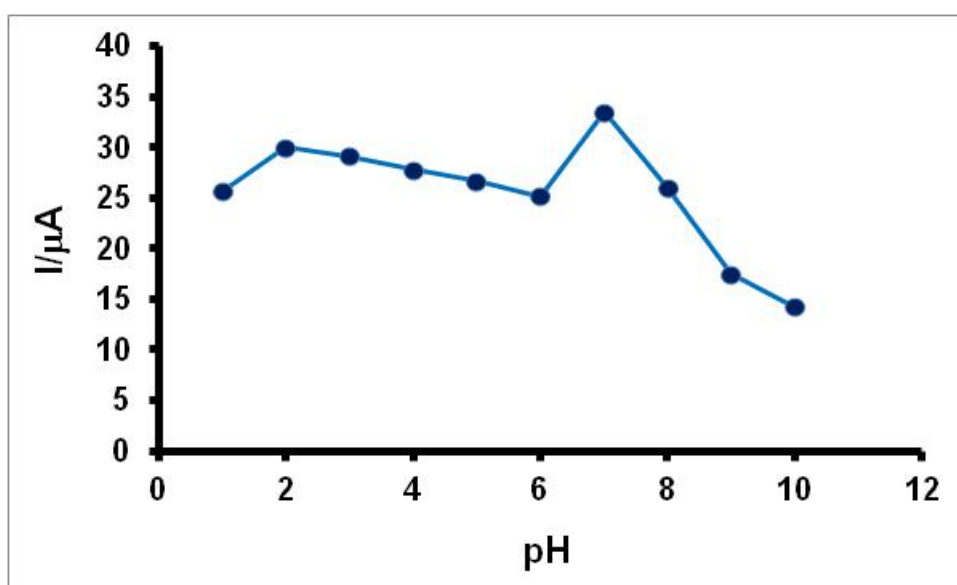
Cyclic voltammogram of (A) PAA/VS-PANI/LuPc₂/GOx-MFH, (B) PAA-rGO/LuPc₂/GOx-MFH for (a) 0 mM glucose (b) 4 mM glucose in 0.1M PBS (pH 7.0)

SI-6

Optimisation of PAA-rGO/VS-PANI/LuPc₂/GOx-MFH biosensor performance

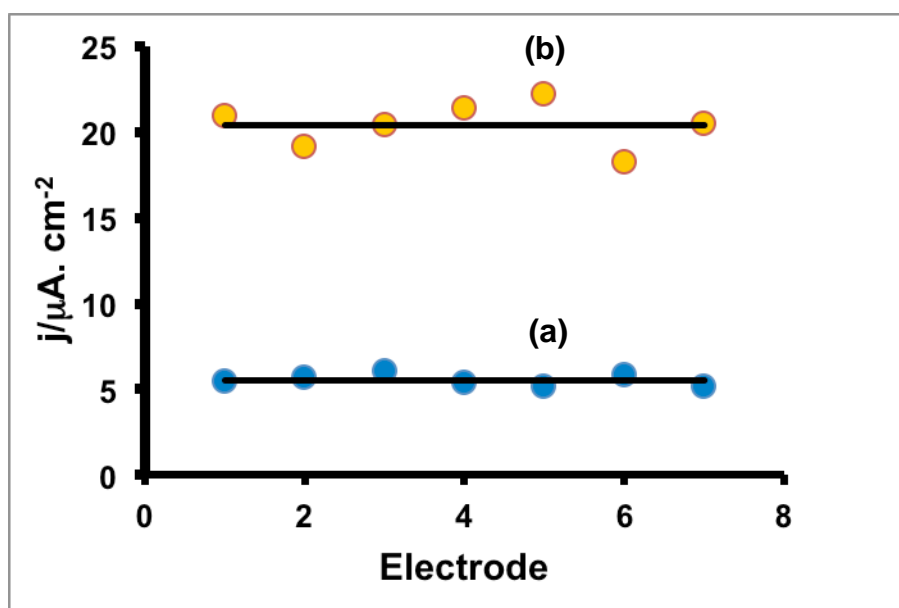
Optimisation studies were performed with the PAA-rGO/VS-PANI/LuPc₂/GOx-MFH biosensor in stirred solution was found to be dependent on pH. Fig. SI-5 shows the effect of pH on the oxidation current of glucose at the PAA-rGO/VS-PANI/LuPc₂/GOx-MFH biosensor. Initially the current value rises at pH 2.0 and then found to be decreased; later at around pH 7.0, the oxidation current increases steeply, then reaches a maximum value. Hence 0.1 M PBS (pH 7.0) is chosen as a medium buffer for further determination of glucose.

The effect of potential on the steady-state current for the PAA-rGO/VS-PANI/LuPc₂/GOx-MFH biosensor is studied. The applied potential of +0.3 V to +0.6 V in 0.1 M PBS (pH 7.0) does not show significant variation in the response current of glucose and hence +0.3 V is chosen as the applied potential for amperometric detection of glucose concentration.



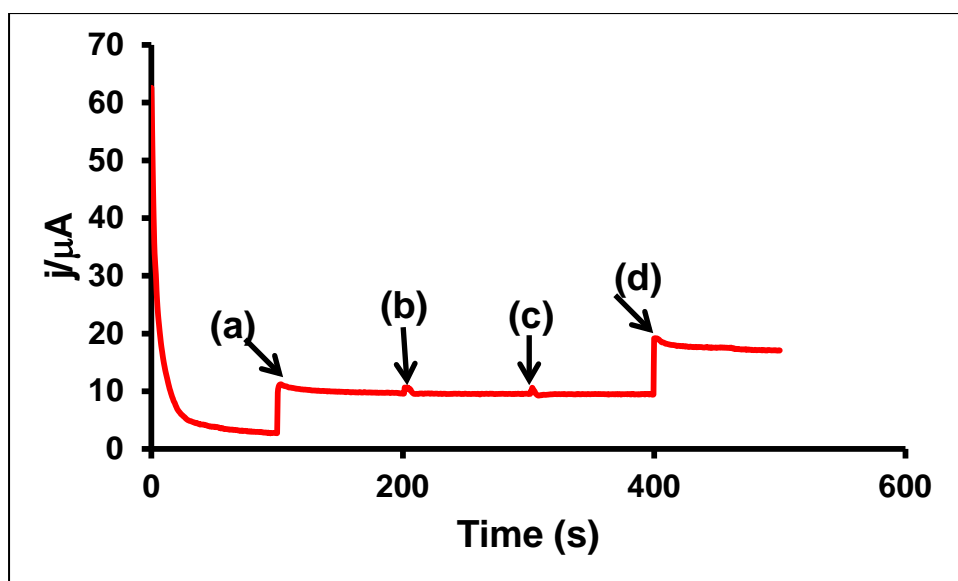
Effect of pH on the current response of glucose at PAA-rGO/VS-PANI/LuPc₂/GOx-MFH biosensor

SI-7

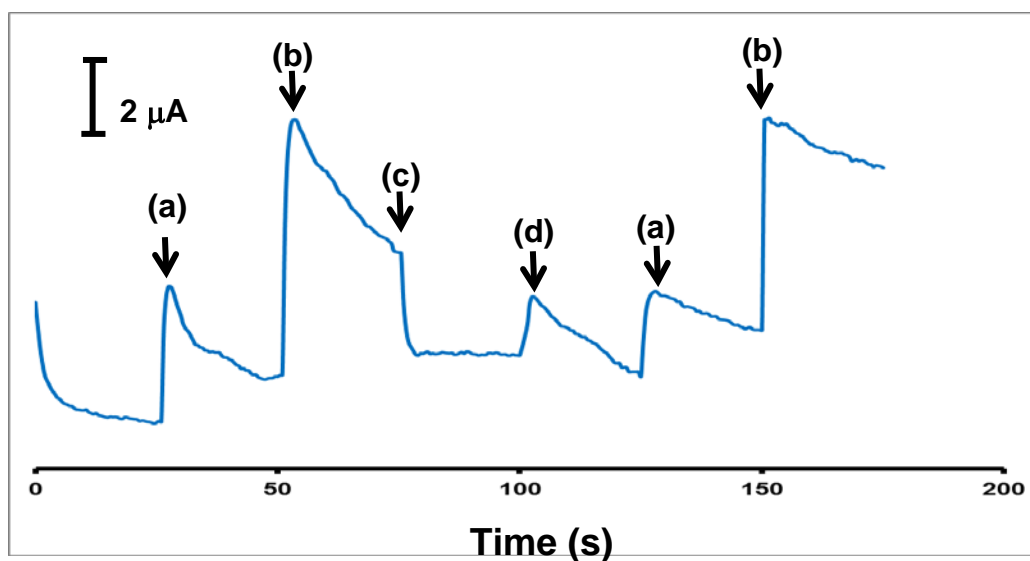


Amperometric response of (a) 4 mM (b) 6 mM at PAA/VS-PANI/LuPc₂/GOx-MFH biosensor (repetitive measurements)

SI-8



Amperometric response of (a) glucose (4 mM); (b) ascorbic acid (0.1 mM); (c) uric acid (0.5 mM); (d) glucose (4 mM) at PAA/VS-PANI/LuPc₂/GOx-MFH biosensor (Interference measurement)



Amperometric responses of real samples (a) glucose, (b) juice 1, (c) juice 2, (d) human serum, at PAA/VS-PANI/LuPc₂/GOx-MFH biosensor at an applied potential of +0.3 V.

Table 2. Amperometric responses of real samples

Real samples	Added (according to specification in the label) (mM)	Found (mM)	Recovery (%)
Glucose	4	4.13	103.25
Juice 1	7.5	7.78	103.76
Juice 2	2.5	2.44	97.6
Human serum	-	3.86	-