Supporting Information

Printable hetero-structured bioelectronic interfaces with enhanced electrode reaction kinetics by inter-microparticle network

Rodtichoti Wannapob,[a,b] Mikhail Yu. Vagin,[a,d] Yu Liu,[a,e] Panote Thavarungkul,[c] Proespichaya Kanatharana,[b] Anthony P.F. Turner,[a] Wing Cheung Mak*[a]

[a]Biosensors and Bioelectronics Centre, Department of Physics, Chemistry and Biology, Linköping University,
SE-581 83, Linköping, Sweden.
[b]Department of Chemistry, Faculty of Science, Prince of Songkla University, Hat Yai, Songkla, 90112, Thailand.
[c]Department of Physics, Faculty of Science, Prince of Songkla University, Hat Yai, Songkla, 90112, Thailand
[d]Laboratory of Organic Electronics, Department of Science and Technology, Linköping University, Norrköping,
Sweden
[e]College of Life and Science, Sichuan Agricultural University, Yaan 625014, People's Republic of China.

*Corresponding author

Tel: +46 (0)13286921; e-mails: wing.cheung.mak@liu.se

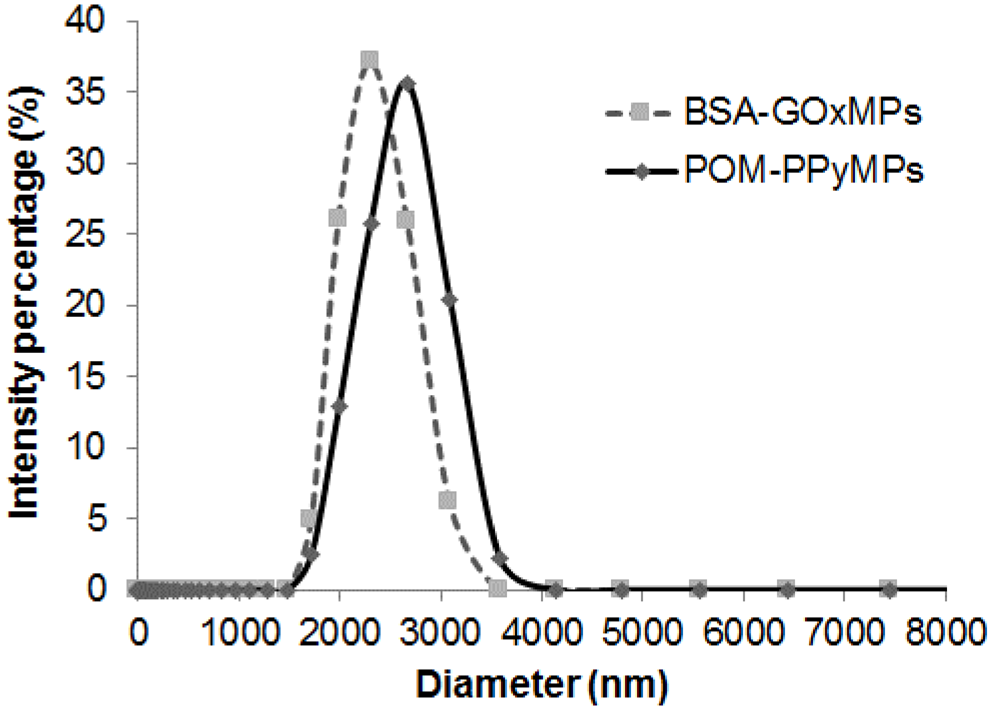

Figure S1. Particle size distribution curves of BSA-GOxMPs and POM-PPyMPs, respectively.

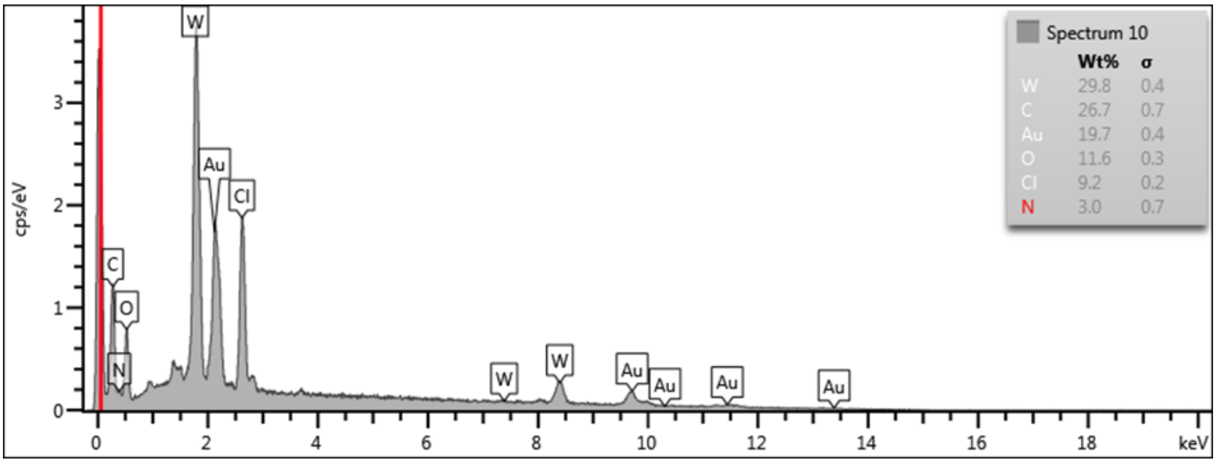

Figure S2. EDX spectrum of POM-PPyMPs.

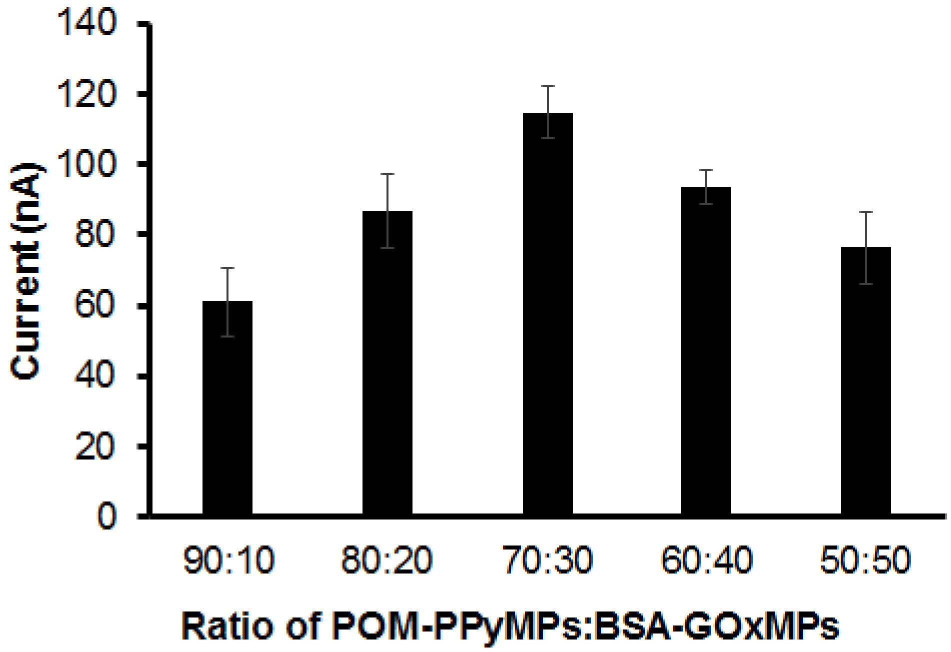

Figure S3. The signal responses for amperiometric detection (0.5 V) of 1.0 mM glucose with modified electrodes prepared by different ratio of POM-PPyMP and BSA-GOxMP as 90:10, 80:20, 70:30, 60:40 and 50:50 v/v, respectively.

A)

B)

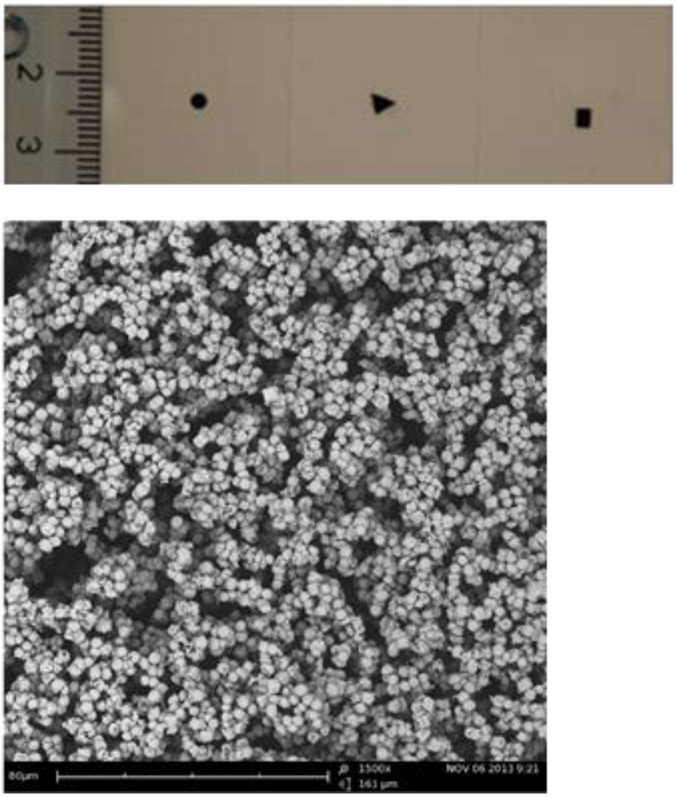

Figure S4. (A) Microparticle film with different shapes and (B) SEM image of microparticle film structure.

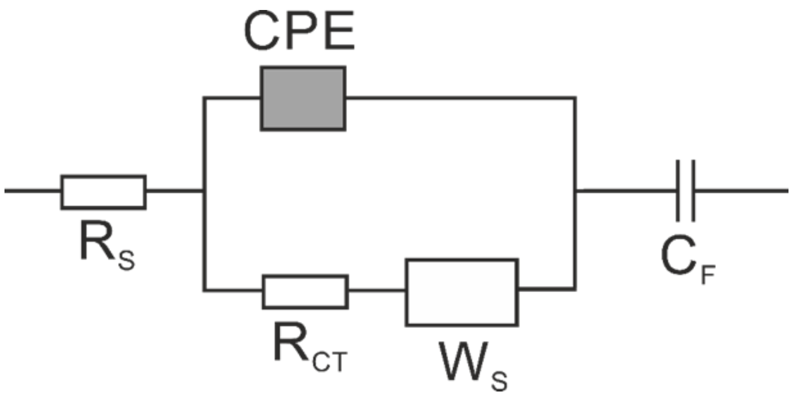

Figure S5. The distributed equivalent circuit.

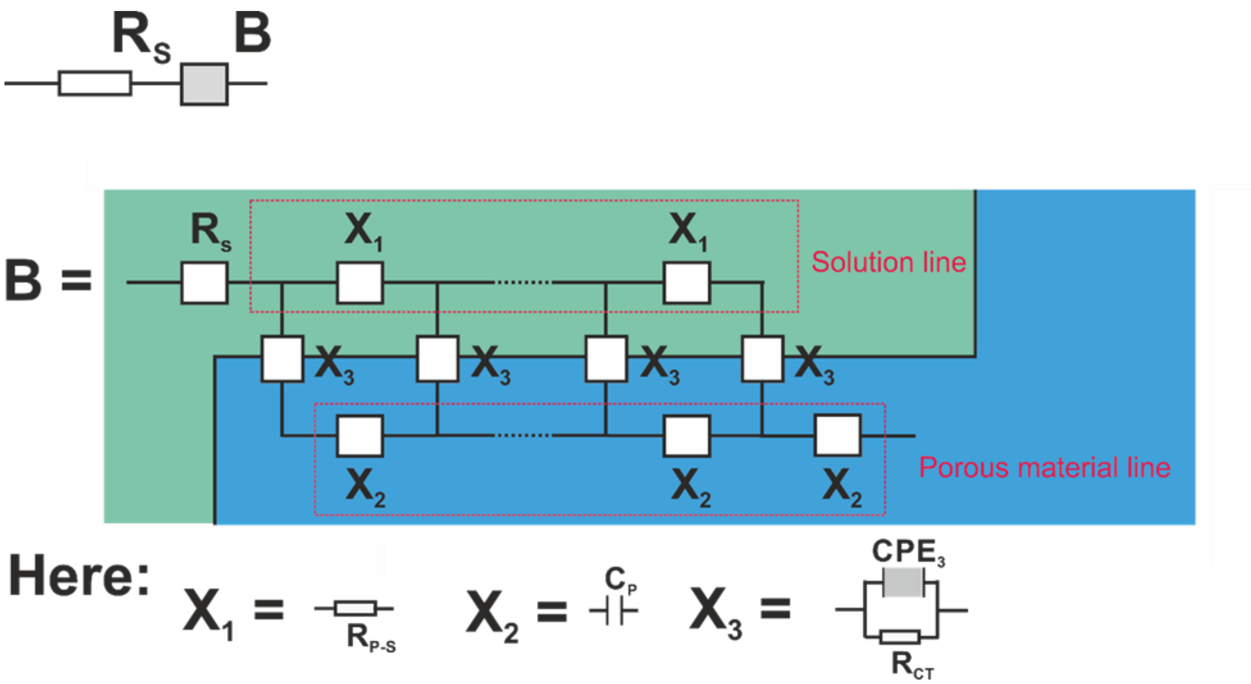

Figure S6. Transmission line equivalent circuit.

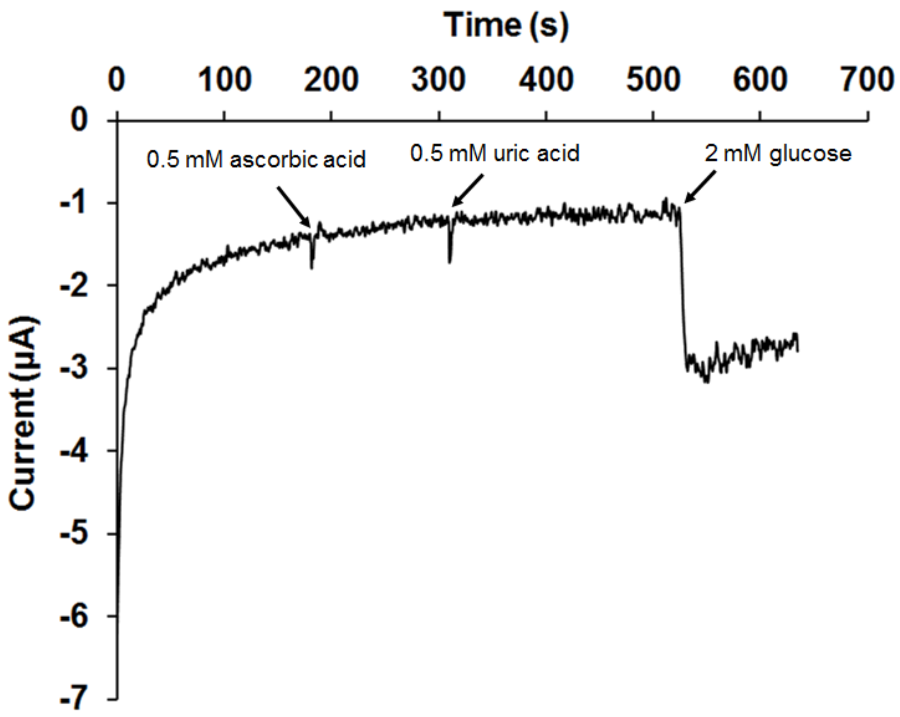

Figure S7. Time-current curve of the hetero-structured glucose biosensor packaged with 0.05% Nafion in response to the addition of 0.5 mM uric acid, 0.5 mM ascorbic acid and 2 mM glucose, respectively.

Table S1. Fitted parameters of distributed equivalent circuit.

Element		Membrane					
		Hetero-structured			Layer-structured		
		blank	+ 2 mM glucose	Change $\frac{\lvert X_0-X\rvert}{X_0}*100$, %	blank	+ 2 mM glucose	Change $\frac{\lvert X_0-X\rvert}{X_0}*100$, %
R_S	[Ω]	70.7	70.2	0.7	142.1	142.2	0.1
CPE	[μΩ s^{-n}]	1.34	1.46	9	1.24	1.51	21.8
n_1		0.91	0.90	1.1	0.91	0.88	3.3
$C=\left(CPE_3*(R_S)^{(1-n3)}\right)^{\frac{1}{n3}}$ (Jovic and Jovic. 2003, J. Electroanal. Chem. 141, 1-11)	[μF]	0.57	0.55	3.5	0.53	0.52	1.9
R_{CT}	[mΩ]	1.97	1.46	25.9	7.25	7.08	2.3
W_1	[kΩ s^{-1}]	72.50	51.25	29.3	52.8	46.3	12.3
W_2		1.77	0.99	44.1	3.57	5.07	42
n_2		0.32	0.27	15.6	0.31	0.27	12.9
$L=(W_2)^{1/n2}$		5.9	0.9	84.7	60.4	372.0	515.9

Table S2. Fitted parameters of transmission line equivalent circuit.

Element		Membrane					
		Hetero-structured			Layer-structured		
		blank	+ 2 mM glucose	Change $\frac{\lvert X_0 - X \rvert}{X_0} * 100$, %	blank	+ 2 mM glucose	Change $\frac{\lvert X_0 - X \rvert}{X_0} * 100$, %
R_S	[Ω]	70	70	0	147.1	149.2	1.4
$R_{P\text{-}S}$	[Ω]	382.6	378.7	1	3.3×10^{-5}	6.4×10^{-5}	93.9
C_P	[μF]	0.55	0.53	3.6	0.51	0.51	0
R_{CT}	[Ω]	964	582	39.6	898	707	21.2
CPE_3	[μΩ s^{-n}]	0.89	0.79	11.2	1.84	2.07	12.5
n_3		0.52	0.54	3.8	0.45	0.42	6.7
$C_3 = \left(CPE_3 * (R_S)^{(1-n3)}\right)^{\frac{1}{n3}}$ (Jovic and Jovic. 2003, J. Electroanal. Chem. 141, 1-11)	[μF]	70	68	2.9	340	422	24.1