Electronic Supplementary Information

Electrochemical reactive oxygen species detection by cytochrome *c* immobilized with vertically aligned and electrochemically reduced graphene oxide on glassy carbon electrode

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Electrochemical characterizations of vertically aligned electrochemically reduced graphene oxide (VAErGO) on glassy carbon electrode (GCE)



Fig. S1 Cyclic voltammograms of bare GCE (a) and VAErGO/GCE (b) in 5 mM $[Fe(CN)_6]^{3-1}$ prepared in 0.1 M KCl at the scan rate of 50 mV·s⁻¹.



Fig. S2 (A) Cyclic voltammograms of VAErGO/GCE in 5 mM $[Fe(CN)_6]^{3-}$ prepared in 0.1 M KCl at different scan rates, (B) Peak current *vs.* square root of scan rates plot of bare GCE and VAErGO/GCE.

Direct electron transfer (DET) rate constant (k_{et}) of cytochrome c

Each peak current value was increased linearly with increasing scan rates (Fig. S3A). The E_{pa} and E_{pc} values obtained were plotted (Fig. S3B) against the logarithm of the scan rate to calculate DET rate constant (k_{et}). The redox peak potentials were slightly shifted (E_{pa} was shifted positively and E_{pc} was shifted negatively) when the scan rates increased to higher than 200 mV·s⁻¹. Above this scan rate, E_{pa} and E_{pc} were linearly increased in agreement with the Laviron theory¹, and the apparent k_{et} can be determined according to the simplified equation:²

$$k_{et} = \frac{\alpha n F \nu_c}{RT} = \frac{(1 - \alpha) n F \nu_a}{RT}$$

the charge-transfer coefficient (α) is assumed to be 0.5; the number of electrons (n) is 1; the scan rates (v_a and v_c) are the intercepts of the linear plots for the anodic or the cathodic peaks; the parameters of F, R and T have their usual meanings; the calculated ΔE_p value is smaller than 200 mV.

E. Laviron, J. Electroanal. Chem., 1979, 101, 19-28.
G.-X. Wang, M. Wang, Z.-Q. Wu, W.-J. Bao, Y. Zhou and X.-H. Xia, Analyst, 2013, 138, 5777-5782.



Fig. S3 (A) Plots of scan rate *vs.* peak current and (B) Plots of ln [scan rate] *vs.* E_p (scan rates ranged from 25 mV·s⁻¹ to 1000 mV·s⁻¹).