Electronic Supplementary Information

Cholate Adsorption Behavior at Carbon Electrode Interface and Its Promotional Effect in Laccase Direct Bioelectrocatalysis

Masato Tominaga*, Motofumi Tsutsui, Takuya Takatori

Graduate School of Science and Engineering, Saga University, Saga 840-8502, Japan
* Correspondence: masato@cc.saga-u.ac.jp; Tel.: +81-952-28-8561

Results and Discussion

Simulated analysis of steady-state current density

The steady-state current density (j_s) for the adsorption model is given by [1-4]

$$j_a = nFk_c\Gamma_a \, / \, [1 + (k_c/k_f) + (k_b/k_f)]$$

$$k_f = k° \exp\left[-\alpha \, (nF/RT) \, (E - E°')\right]$$

$$k_b = k° \exp\left[(1 - \alpha) \, (nF/RT) \, (E - E°')\right] \qquad (1)$$

where n and F are the number of electrons ($n = 1$ for the T1 Cu site of Lac) and the Faraday constant, respectively; k_c is the catalytic constant (s^{-1}), and was assumed to be 2600 s^{-1} because the theoretical rate of O_2 reduction by the T2/3 Cu site of bilirubin oxidase is expected to be as high as 2600 s^{-1} under air-saturated conditions [5,6]; k_f and k_b are the surface electron transfer rate constants expressed by the Butler–Volmer equation; and $E°'$ is similar to the formal redox potential for the T1 Cu site of Lac. In this study, $E°'$ was estimated from the half-wave potential from the steady-state sigmoidal wave obtained at each modified SWCNT electrode. $k°$ and α are the heterogeneous electron transfer rate constant (s^{-1}) at $E°'$ between the adsorbed Lac and SWCNT electrode, and the transfer coefficient, respectively. In this study, $k°$, Γ_a, and α were adjustable parameters. We assumed that the dependence of the catalytic reduction current on the mass transport of oxygen could be ignored.

References

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