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Copper-Zinc Superoxide Dismutase (CuZn-SOD) Electrochemical Catalytic Amplification Sensing at Pt Ultramicroelectrodes

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Supplementary Information

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Catalytic amplification numerical data analysis

Table SI 1. Some examples of peaks analysis by catalytic amplification.

I $_{initial}$ (A)	**I $_{final}$ (A)**	**ΔI**	**r (cm) distance from active site**	**r (nm) distance from active site**
3.08E-11	3.11E-11	2.80E-13	8.67E-08	0.87
2.14E-11	2.18E-11	3.90E-13	1.21E-07	1.21
1.86E-11	1.88E-11	2.50E-13	7.74E-08	0.77
2.33E-11	2.36E-11	2.30E-13	7.12E-08	0.71
2.73E-11	2.75E-11	2.10E-13	6.50E-08	0.65
1.79E-11	1.82E-11	3.40E-13	1.05E-07	1.05
2.03E-11	2.06E-11	2.80E-13	8.67E-08	0.87

$$r = \Delta I/4\pi(\ln 2)nFDC \qquad (1)$$

Where
n = # of e- transferred during the process
F = Faraday's constant
D = diffusion coefficient of O_2 at 20 °C in a ~100 mM salt solution [1]
C = concentration of O_2 in saturation for aqueous solution [2]

Calculation of theoretical diffusion coefficient using Stokes-Einstein equation

Stokes-Einstein approximation is described by the following equation [3]:

$$D_E = \frac{k_B T}{6\pi\eta r} \qquad (2)$$

where k_B is Boltzmann's constant, T is absolute temperature (298.15 K) for these set of experiments, η is the solution's viscosity, and r is the nanoparticle's radius (2.1 x 10^{-9} m used as theoretical radius). The value obtained using this calculation was 1.24 x 10^{-6} cm^2/s.

Frequency of collisions and experimental diffusion coefficient

The experimental frequency of collisions was calculated using the number of peaks per 300 s ratio. These values were plotted against the enzyme concentration in solution. Since frequency of collision due to diffusion (*f*) can be described as follows[4]:

$$f = 4D_E C_E r_{elec} N_A \qquad (3)$$

the experimental diffusion coefficient was calculated using the experimental frequency at known concentration:

$$\text{i.e. } (C_E = 0.9 \text{ fM});\ D_E = \frac{f}{4C_E\, r_{elec} N_A}\ \frac{.00333\ s^{-1}}{(4)(9E^{-19}\frac{mol}{cm^3})(6.02E^{23}\ mol^{-1})(5E^{-4}\ cm)} = 3.08 \times 10^{-6}\ cm^2/s$$

The magnitude of the experimental diffusion coefficient was 1 x 10^{-6} cm^2/s regardless of the concentration used for the positive slope lineal area.

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