Electronic Supplementary Information for:

Average Collision Velocity of Single Yeast Cells during Electrochemically Induced Impacts

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Contents:

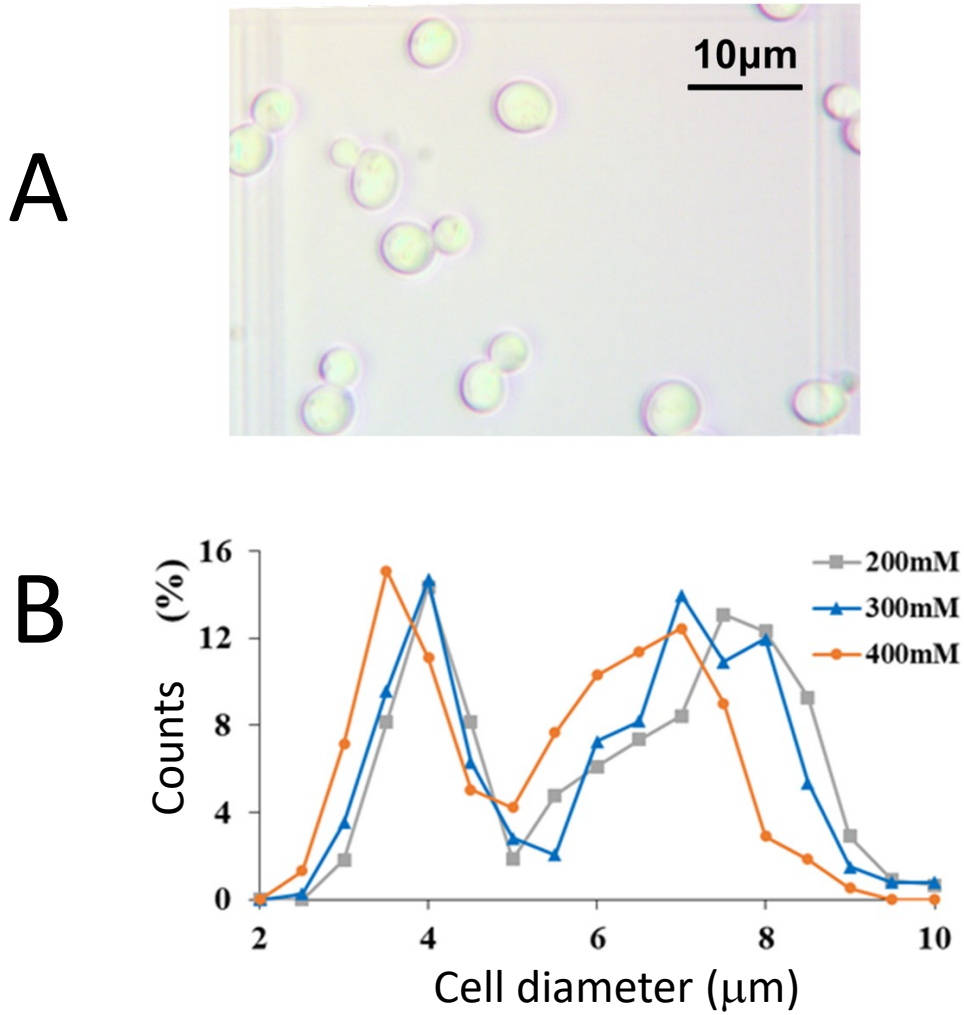Microscopic image and diameter distribution of yeast cells

Figure S1. A) Microscopic image of yeast cells in solution of 100mM potassium chloride (KCl) and 400mM ferrocyanide (FCN). B) Size distribution of cells with increasing ferrocyanide FCN concentration.

Microscopic image of 12.5 µm ultramicroelectrode (UME) and CVs of increasing ferrocyanide (FCN) and UME radius (r_e)
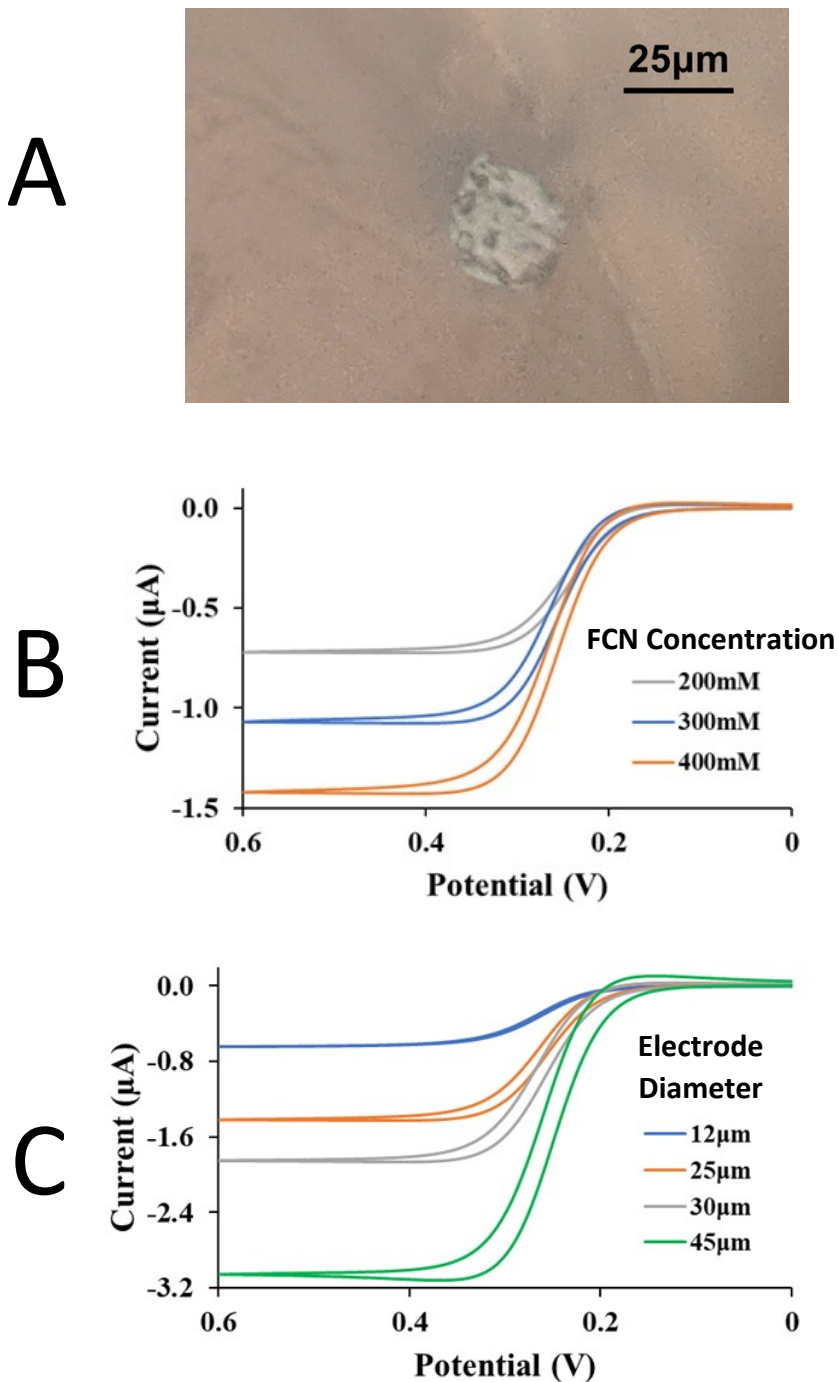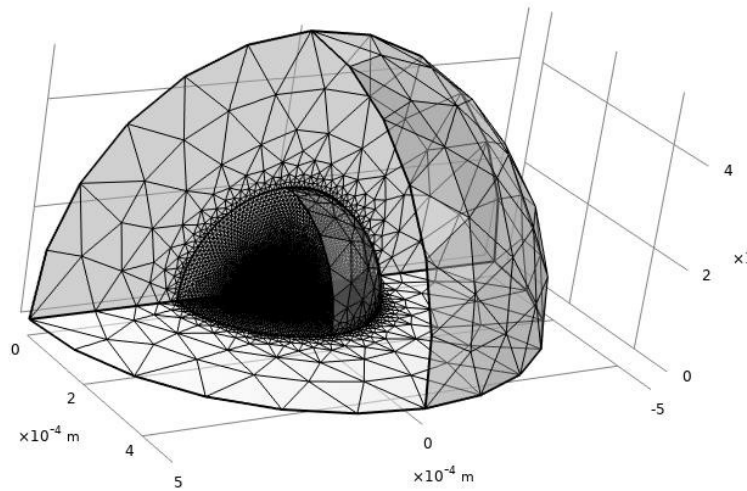

Figure S2. A) Microscopic image of platinum UME r_e = 12.5 µm. CV of B) 100mM KCl and UME r_e = 12.5 µm with increasing FCN concentration and C) 100mM KCl and 400mM FCN with increasing UME.

Inner domain, outer domain, and particle meshing for finite element simulation

Domain

A

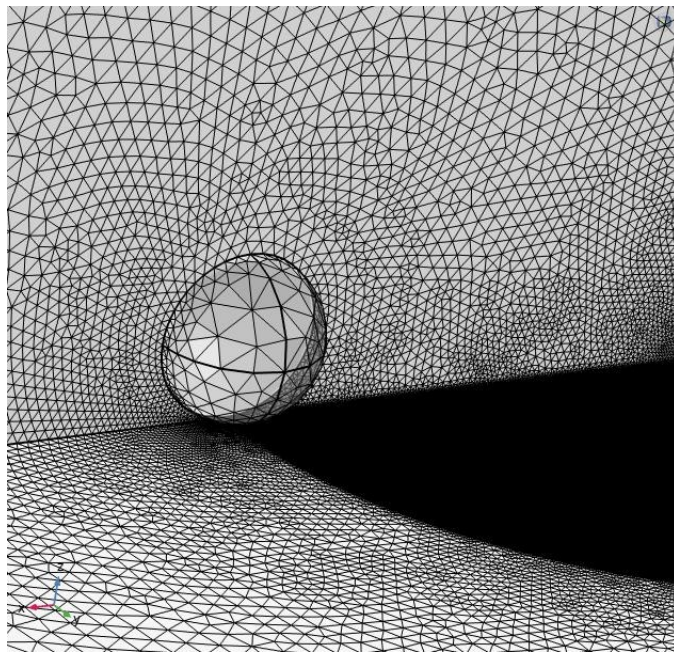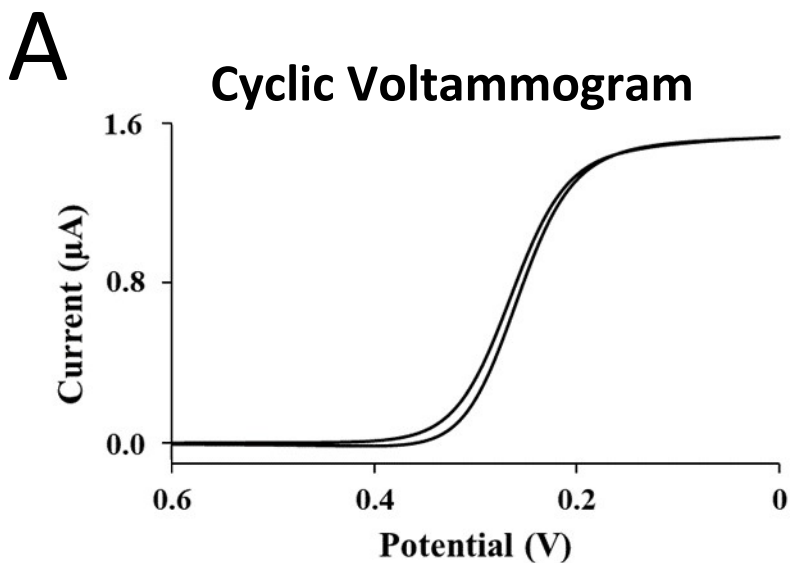

Particle Generation

B

Figure S3. Meshing of A) 200 μm radius inner domain and B) 500 μm radius outer domain with 2 μm radius insulating sphere on edge of UME r_e = 12.5 μm.

CV and *i-t* response of ferricyanide Fe(CN)$_6^{3/4+}$ reduction

A

Cyclic Voltammogram

12.5µm UME

100mM KCl

400mM ferricyanide

B

i-t Plots

Yeast

— 0fM
— 48fM

12.5µm UME
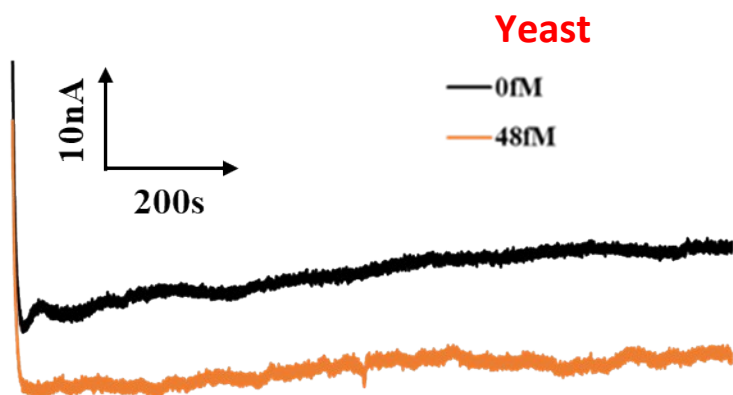
100mM KCl

400mM ferricyanide

+0V vs Ag/AgCl

Figure S4. A) CV and B) *i-t* response with 0fM (black) and 48fM (orange) yeast cells. 100mM KCl and 400mM FeCN+ using UME r_e = 12.5 µm.

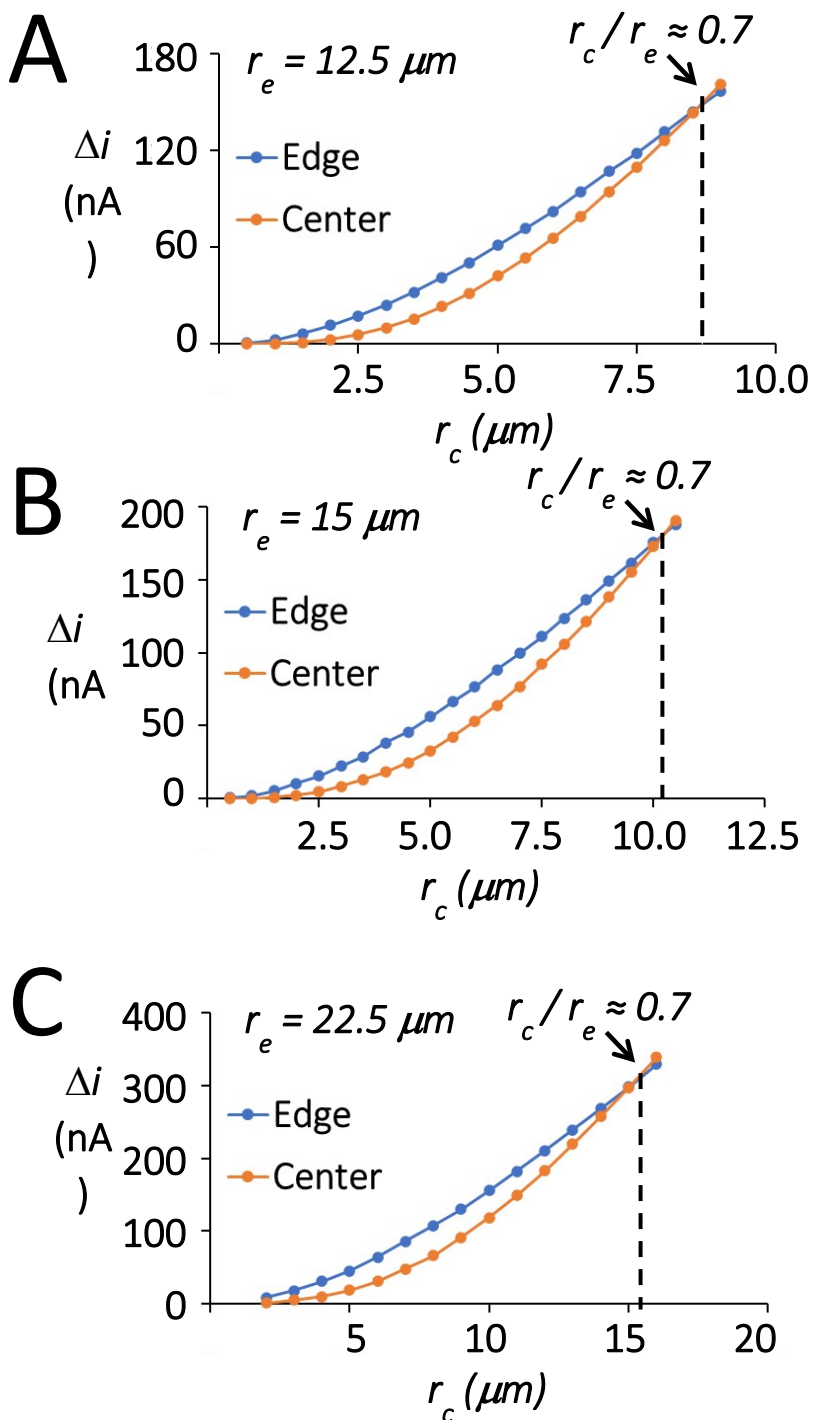Simulated Δ*i*-values for increasing r$_e$ and cell radius (r$_c$)

Figure S5. Simulated D*i*-values (center and edge) for a UME r_e = A) 12.5 µm, B) 15 µm, and C) 22.5 µm. Dashed line shows r_c-value at which both equalize.

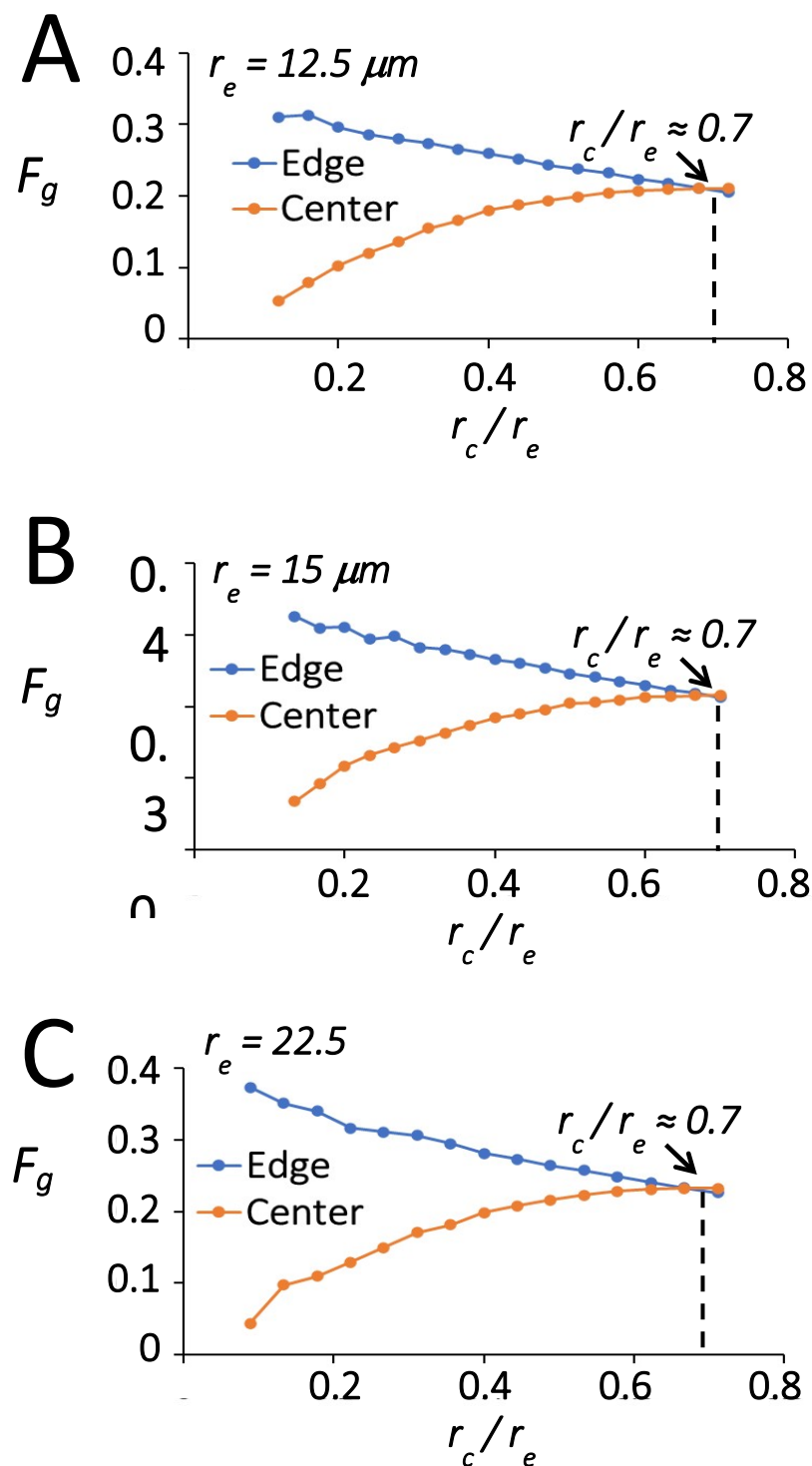Simulated geometric factor (F_g)-values for increasing r_c/r_e ratio

Figure S6. Simulated F_g-values (center and edge) for a UME r_e = A) 12.5 μm, B) 15 μm, C) 22.5 μm.

Redox flux profiles with increasing FCN concentration and r_e

A

FCN Concentration
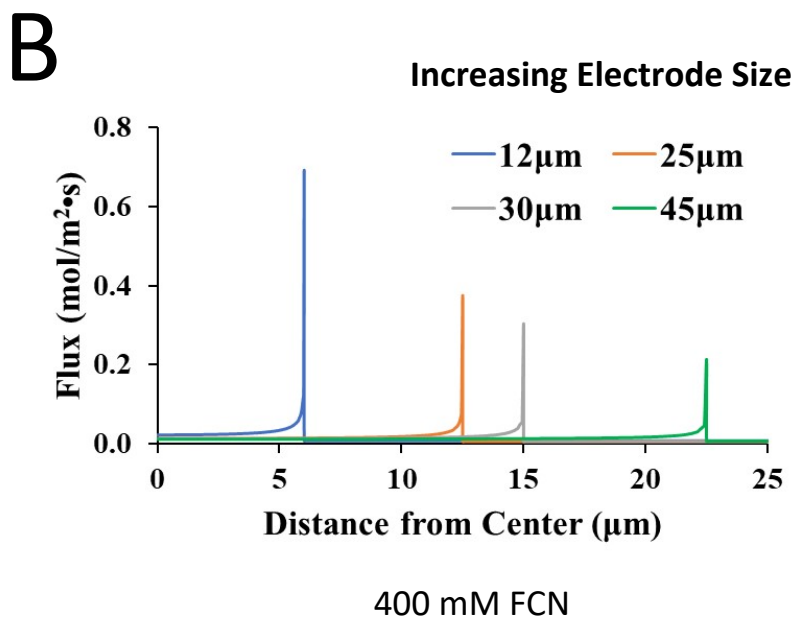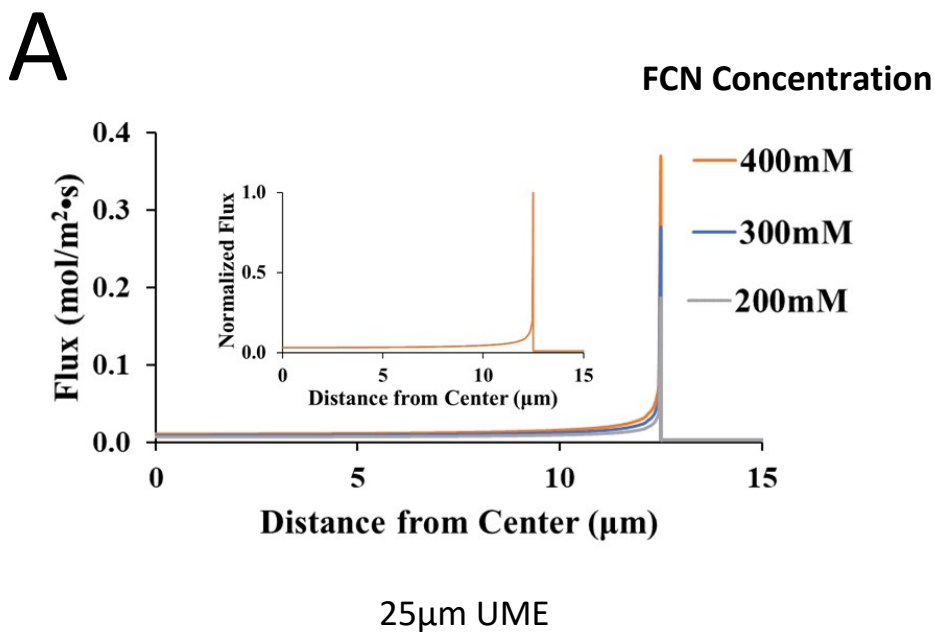

25μm UME

B

Increasing Electrode Size

400 mM FCN

Figure S7. A) Redox flux along the radii of a UME r_e = 12.5 μm with increasing FCN concentration. B) Redox flux along the radii of increasing UME radius and 400 mM FCN.

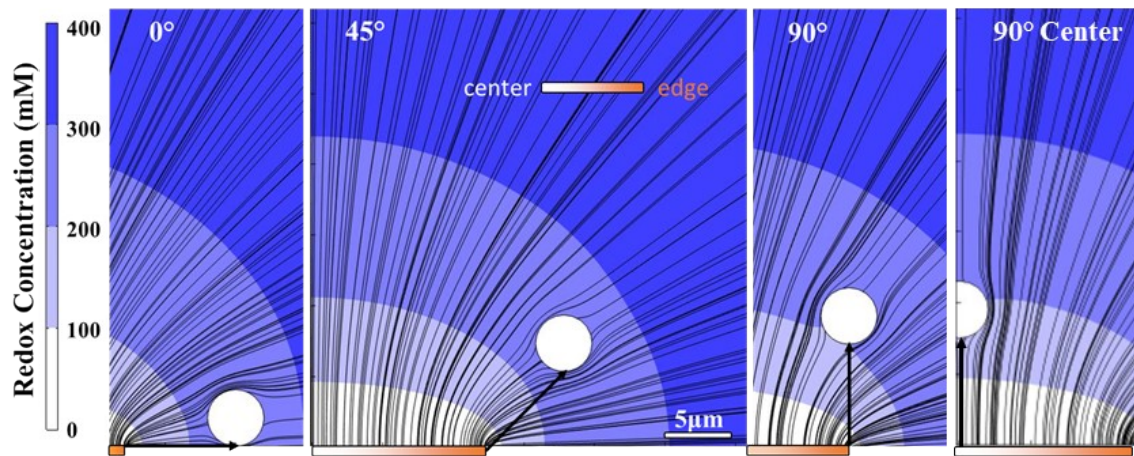Flux disruption by r_c = 2 μm at UME r_e = 12.5 μm with various angle

Figure S8. Simula
2 μm radius cell at
angle.

Table S1 Simulated Current vs. Experiment and Analytical Expression

% error of bare electrode currents (i_B) from simulation respect to experiments and equation S1 at different values of C_{FCN} for r_e = 12.5 µm.

C_{FCN} (mM)	Simulation (nA)	Experimental (nA)	% Error	Eq. S2 (nA)	% Error
200	736	723	1.8	646	13.9
300	1103	1070	3.1	970	13.7
400	1440	1420	1.4	1293	11.4

% error of bare electrode currents (i_B) from simulation respect to experiments and equation S1 as a function of r_e (C_{FCN} = 400 mM).

r_e (mm)	Simulation (nA)	Experimental (nA)	% Error	Eq. S2 (nA)	% Error
6	666	645	3.3	621	7.2
12.5	1440	1420	1.4	1293	11.4
15	1804	1860	3.0	1551	16.3
22.5	2882	3060	5.8	2327	23.9

$$i_{ss} = 4nFD_{FCN}C_{FCN}r_e \qquad\qquad (S1)$$