

Supplementary Materials Appendix for

Microfluidic Electroporation Arrays for Investigating Electroporation-Induced Cellular Rupture Dynamics

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Supporting Table

Table S1. Abbreviation and Nomenclature

DOPC	dioleoyl-phosphatidylcholine
POPC	1-palmitoyl-2-oleoyl-phosphatidylcholine
DMPC	1,2-dimyristoyl-sn-glycero-3-phosphocholine
MβCD	methyl- β -cyclodextrin
PDMS	polydimethylsiloxane
DMEM	Dulbecco's modified Eagle's medium
IDA	interdigitated array
EDTA	Ethylenediaminetetraacetic acid
AC	alternating current
FEM	finite element method
CET	critical electric tension
TMP	transmembrane potential
C_{mem}	membrane capacitance of the cell
r	cell radius
σ_{med}	medium conductivity
f	the applied frequency
E	the applied electric field strength
σ_c	critical electrical tension
CLW	the change of capacitance as water displaces the lipids to form a pore
τ_0	The lifetime of the pore
k_0	dissociation rate constant in the absence of applied force
V_0	a pre-exponential factor (frequency factor $\sim 10^{13} \text{ s}^{-1}$)
k_B	Boltzmann constant
T	absolute temperature
W_0	energy barrier
F	the external force for the reaction
x_b	the reaction coordinate, which means the size of the membrane pore during cell rupture
F_{max}	the mechanical force
σ_e	electrical tension
$R\sigma_e$	the electrical tension rate
ω	angular frequency

Table S2. Comparison between conventional techniques that induce cell perforation and this work.

Method	External energy source	Target	High-throughput analysis	Single cell analysis	Rupture Dynamics $\Delta w, K_B T$ Pore radius (nm)	Ref.	
Molecular dynamics (MD) simulation	Mechanical tension	Lipid bilayer	No	No	10 - 40, $K_B T$ 1-1.45 nm	[18,28, 37,38]	
Micropipette aspiration	Mechanical pressurization	Lipid bilayer	No	Yes	10 - 19.8, $K_B T$ 2 - 3.5 nm	[39-41]	
Micro-indenter, AFM tip	Mechanical compression	Adherent cell Lipid bilayer	No	Yes	N.A.	[42,43]	
patch-clamp amplifier	Electroporation	Adherent/suspension cell	No	Yes	25, $K_B T$ 0.5 nm	[44,45]	
Microfluidics-based Electroporation	Static	Electroporation (Micro-/Nanopillar Arrays Microbead Packing)	Adherent cell	Yes	Yes	N/A	[6,46-49]
	Continuous	Electroporation (Channel Constriction Microelectrode array)	Adherent/suspension cell	Yes	No	N/A	[6,49-52]
*This work	Electroporation (Dielectrophoresis)	Adherent/suspension cell	Yes	Yes	13.59, $K_B T$ 1.07 nm		

Supporting figure

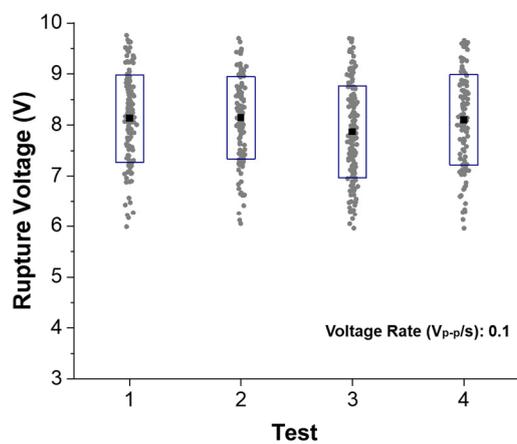


Figure S1. Reproducibility test of the DEP chip. Each test was conducted using the same DEP device with a voltage rate of 0.1 V_{p-p}/s. All data showed no significant variations.