

Supplementary information

Device Fabrication

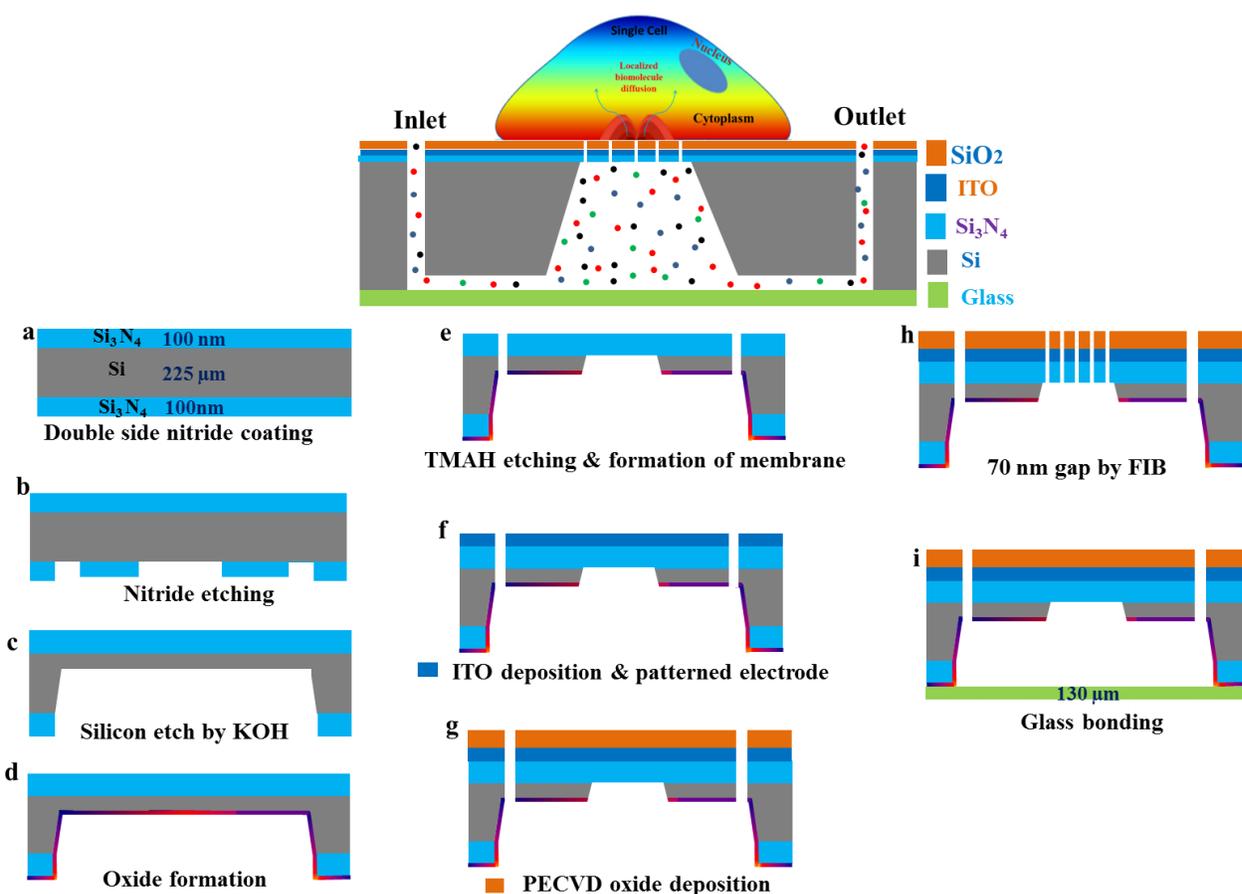


Figure S1: Fabrication process step for NL-SCNEP chip

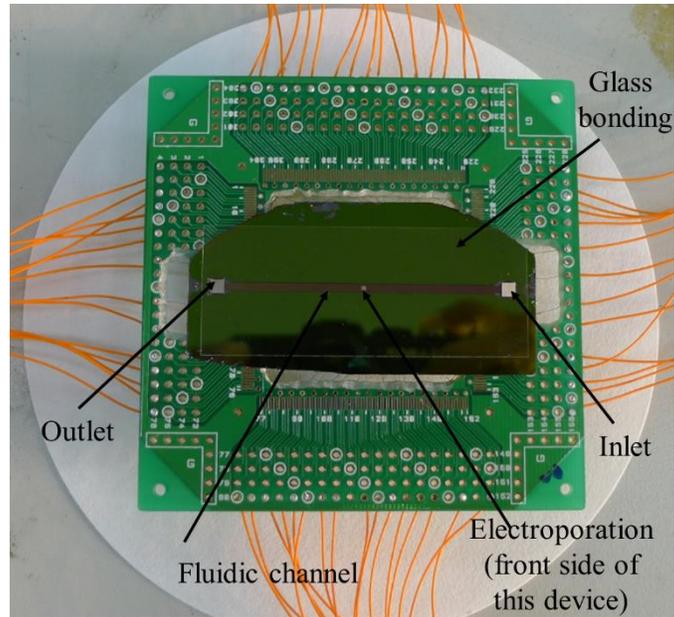


Fig. S2: Back side of the NL-SCNEP chip

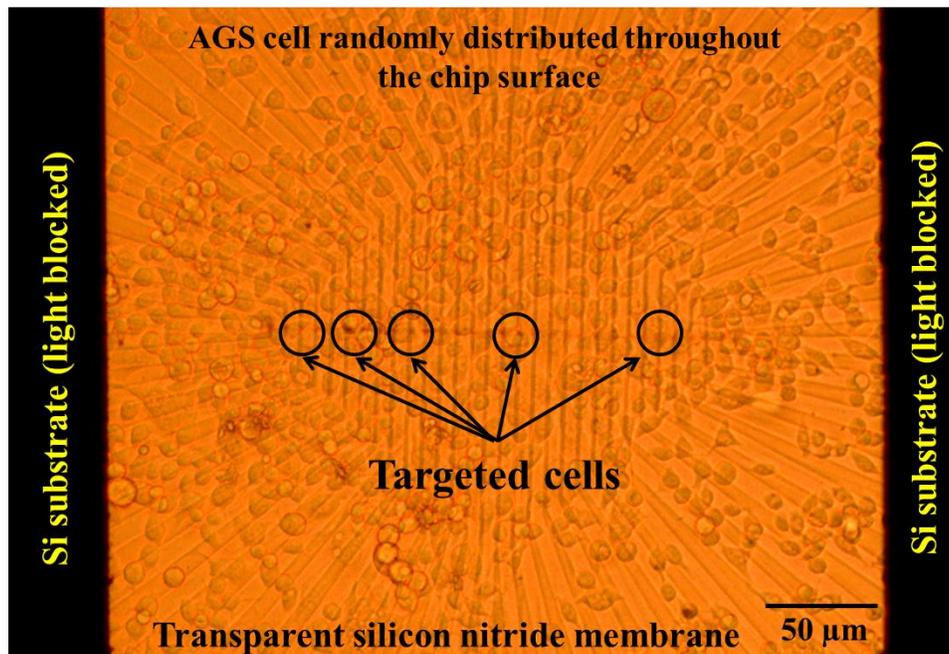


Figure S3: CL1-0 cells seeded on chip surface and some of them are targeted for nano-electroporation experiment (those cells seeded in-between nanoelectrode gap)

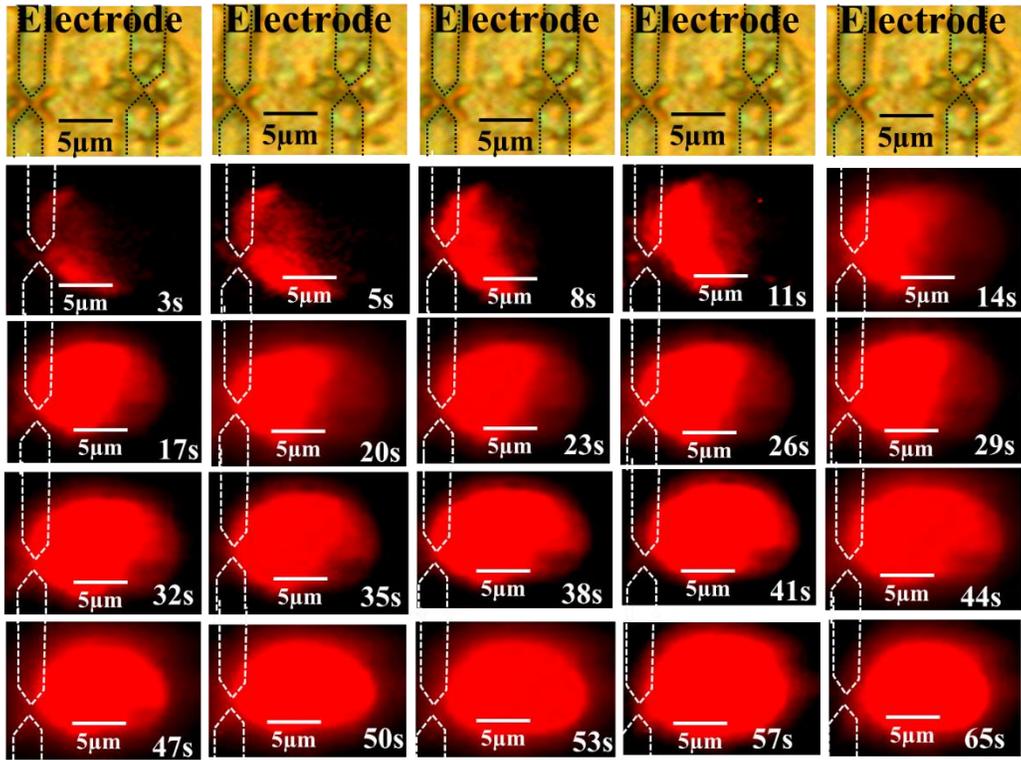


Figure S4: Electric field applied only in single nano-electrode pair of CL1-0 cell with applied voltage 5Vpp, 10 ms single square wave pulse. Here PI dye only diffuse through single nano-localized area of single cell.

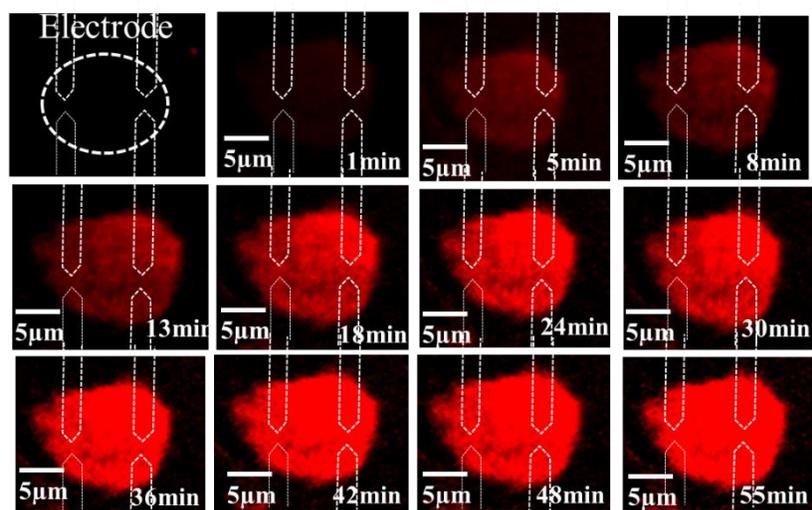


Figure S5: QDs delivery into single AGS cell with applied voltage 6V, 40 ms, two square pulses.

QD successfully deliver within 40~50 minutes.

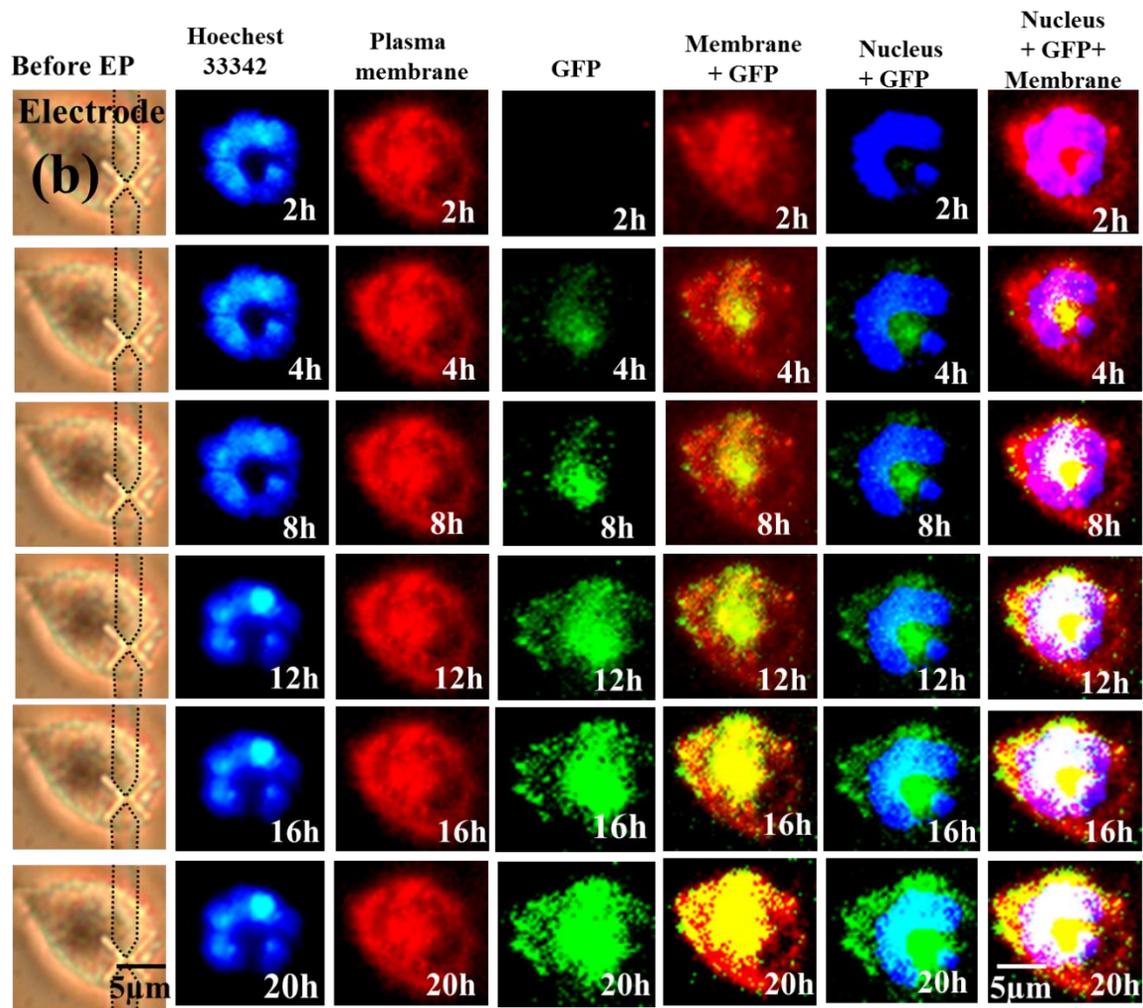


Figure S6: Plasmid (Pmax E₂F₁) delivery into CL1-0 cell with applied voltage 6Vpp ,40ms square wave pulse (3 pulses). Plasmid successfully deliver and protein express into single cell within 20 hrs.

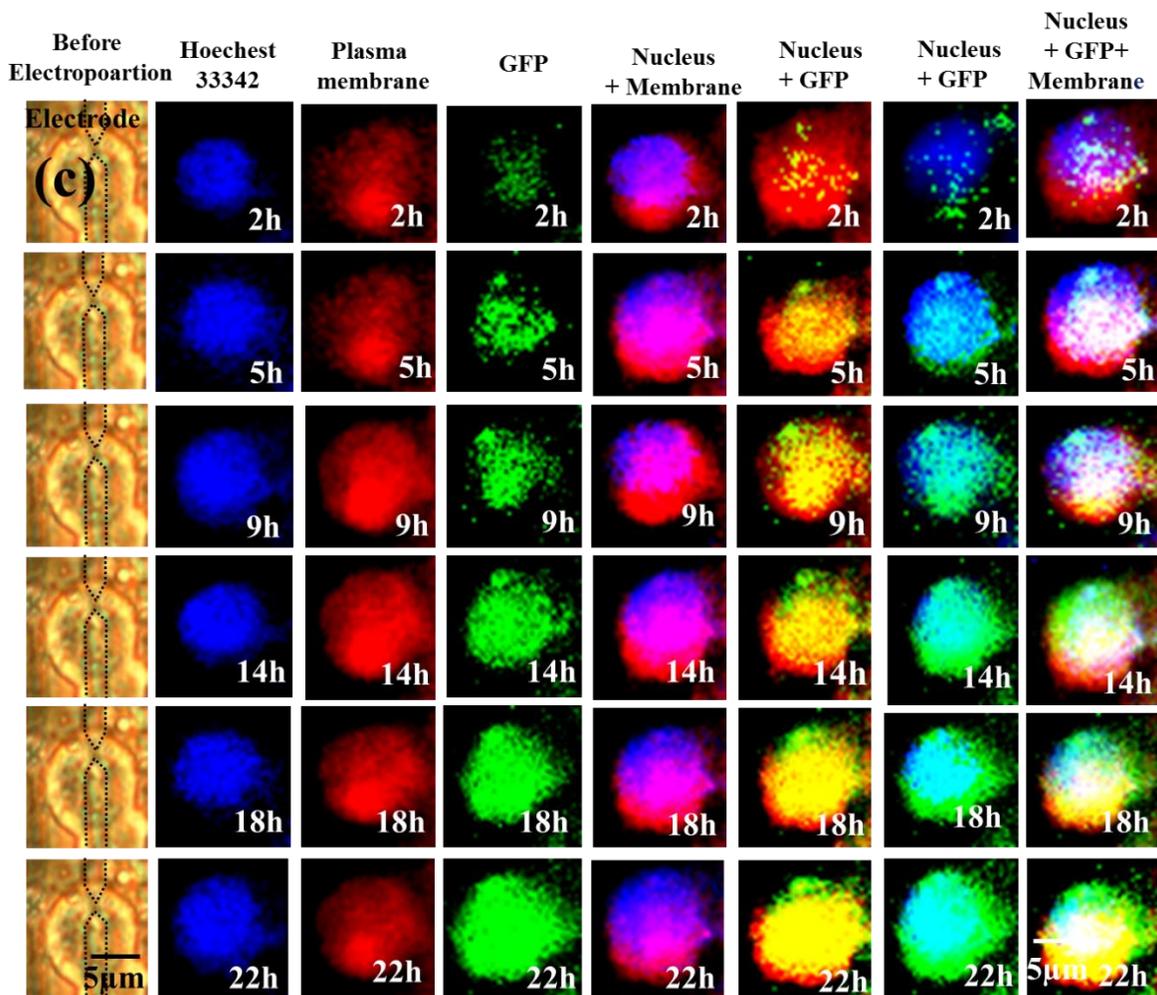
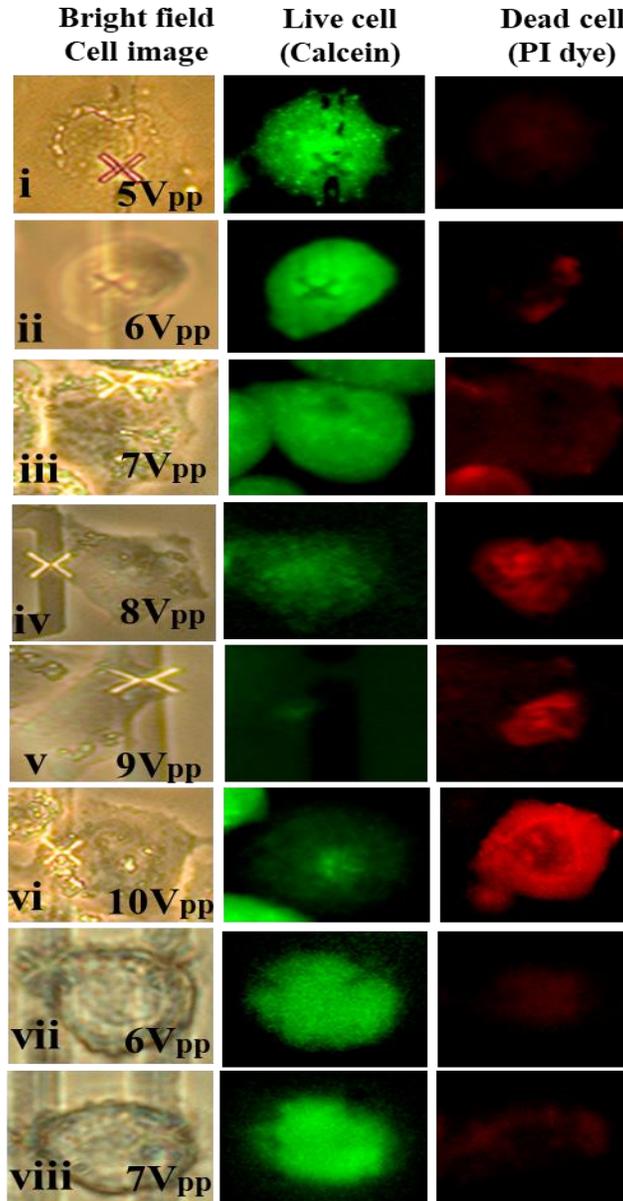
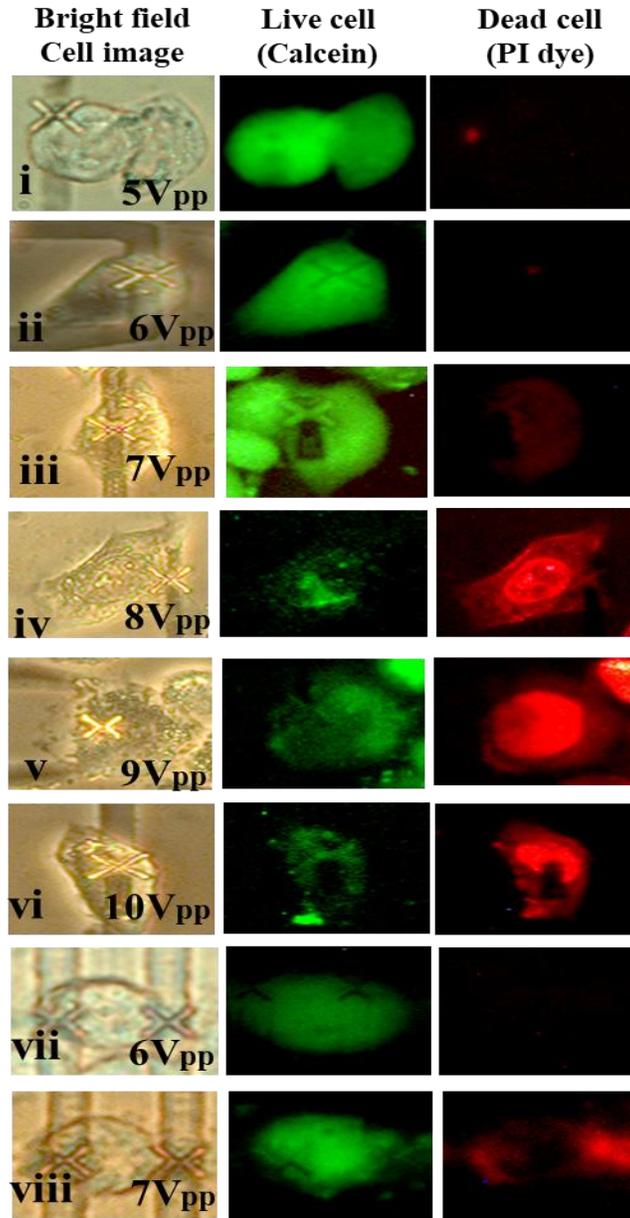


Figure S7: Plasmid delivery (Pmax E₂F₁) into AGS cell with applied voltage 6V, 40ms square wave pulse (3 pulses). Plasmid successfully deliver and protein express into cell within 18~22 hours.



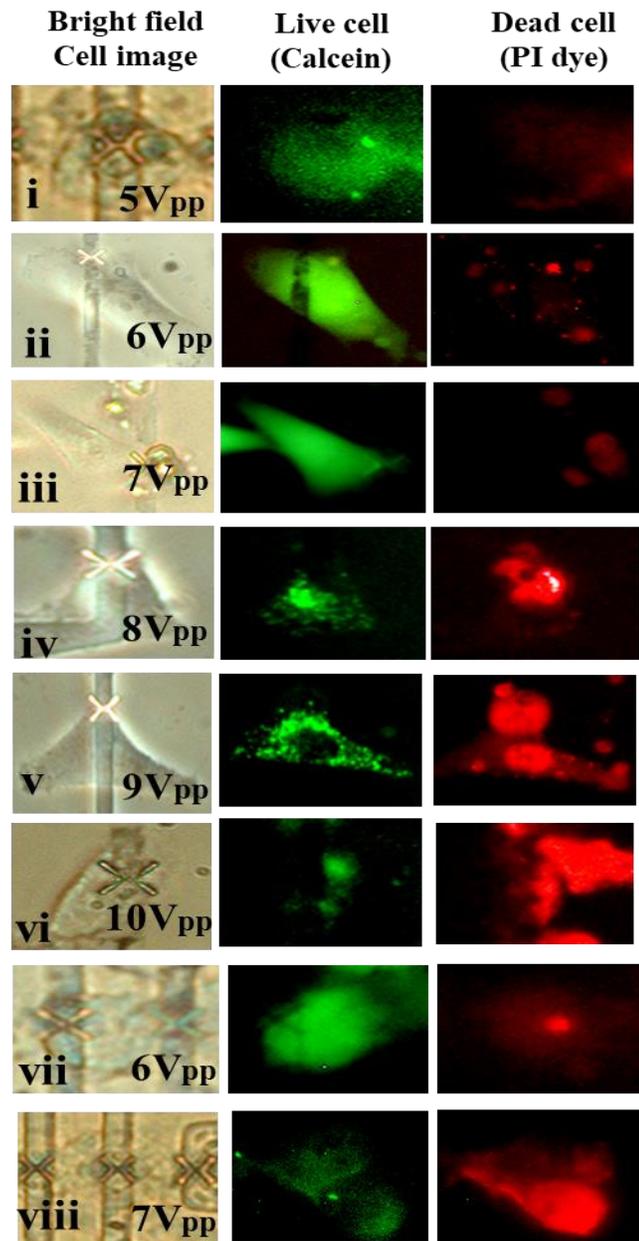
CL1-0 Cell

Figure S8: Viability of CL1-0 cell after single and multiple position nano-electroporation experiment with different applied voltages and fixed pulses (30ms, 3 pulses, i-vi). The result shows approximate 8V_{pp} to 10V_{pp}, with single electrode confinement, cells are dead. The cells are live at 6V_{pp}, 50 ms, 3 pulses (Figure vii) and 7V_{pp}, 50 ms, 5 pulses (Figure viii) with two nano-electrode pair.



HCT-8 Cell

Figure S9: Viability of HCT-8 cell after single and multiple position nano-electroporation experiment with different applied voltages and fixed pulses (30 ms, 3 pulses, i-vi). The result shows approximate 8V_{pp} to 10V_{pp}, with single electrode confinement, cells are dead. The cells are live at 6V_{pp}, 50 ms, 3 pulses (Figure vii) and 7V_{pp}, 50 ms, 5 pulses (Figure viii) with two nano-electrodes pair.



HeLa Cell

Figure S10: Viability of HeLa cell after single and multiple position nano-electroporation experiment with different applied voltages and fixed pulses (30ms, 3 pulses, i-vi). The result shows approximate 8V_{pp} to 10V_{pp}, with single electrode confinement, cells are dead. The cells are live at 6V_{pp}, 50 ms, 3 pulses (Figure vii) and dead at 7V_{pp}, 50 ms, 5 pulses (Figure viii) with two nano-electrodes pair.

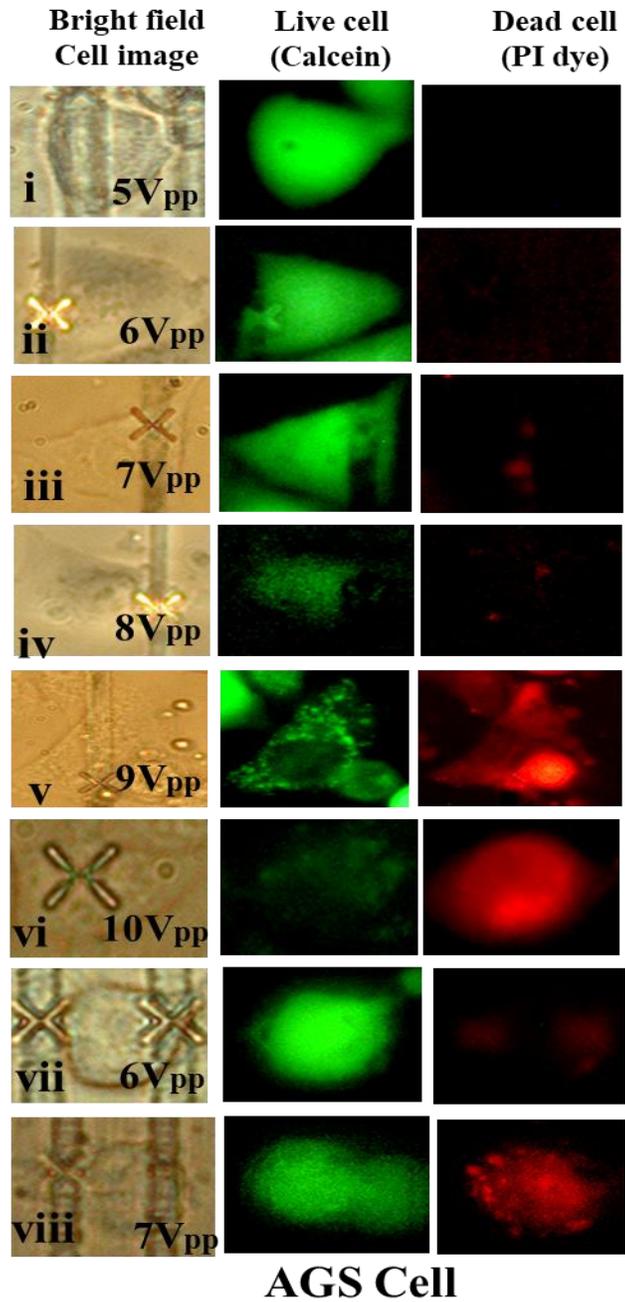


Figure S11: Viability of AGS cell after single and multiple position nano-electroporation experiment with different applied voltages and fixed pulses (15ms, 3 pulses, i-vi). The result shows approximate 9V_{pp} to 10V_{pp}, with single electrode confinement, cells are dead. The cells are live at 6V_{pp}, 50 ms, 3 pulses (Figure vii) and dead at 7V_{pp}, 50 ms, 5 pulses (Figure viii) with two nano-electrodes pair.