MAMMALIAN CELLS ELECTROPORATION IN THE MICROFLUIDIC CHIP

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Electroporation is a technique to increase cell permeability by applying pulsed electric field (PEF) on cells. Electroporation is typically performed using commercially available cuvettes, nevertheless, it can also be performed at the microscale using a microfluidic chip. In this way, cells are exposed to more uniform electric field, favorable chemical environment, heat dissipates faster [1]. Microfluidic chips are usually fabricated using soft-lithography technique with polydimethylsiloxane (PDMS) as a polymer. Though PDMS is biocompatible and has good optical transparency, its main disadvantages are small molecule adsorption and susceptibility to mechanical stress [2]. Off-stoichiometry thiol–ene (OSTE) can be used as an alternative polymer in microchip fabrication overcoming those disadvantages and retaining the advantages of PDMS [3]. Our laboratory has fabricated the OSTE-based microfluidic chip (Fig. 1). Our goal is to test if the microchip is suitable for mammalian cells electroporation. We performed stop-flow and continuous flow electroporation of rat glioma C6 cell line in the microchip. Cell permeability and viability were evaluated using fluorescent spectrophotometry with DAPI and trypan blue test, respectively. Stop-flow electroporation showed an increase of cell permeability to DAPI with increasing electric field from 1.8 kV/cm to 10 kV/cm with 8 pulses, meanwhile with 16 pulses cell permeability has reached the maximum at 1.8 kV/cm. (Fig. 2 (a)). The viability was not influenced with 8 pulses at all tested electric field strengths. In continuous flow electroporation at 1.8 kV/cm, the same permeability increase was reached with 64 and 128 pulses per cell (Fig. 2 (b)). To conclude, the fabricated microchip is suitable for the PEF treatment of mammalian cells.

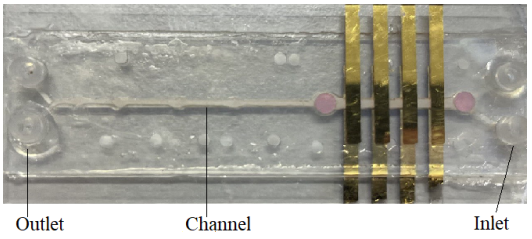

Fig. 1. Microfluidic chip for cell electroporation.

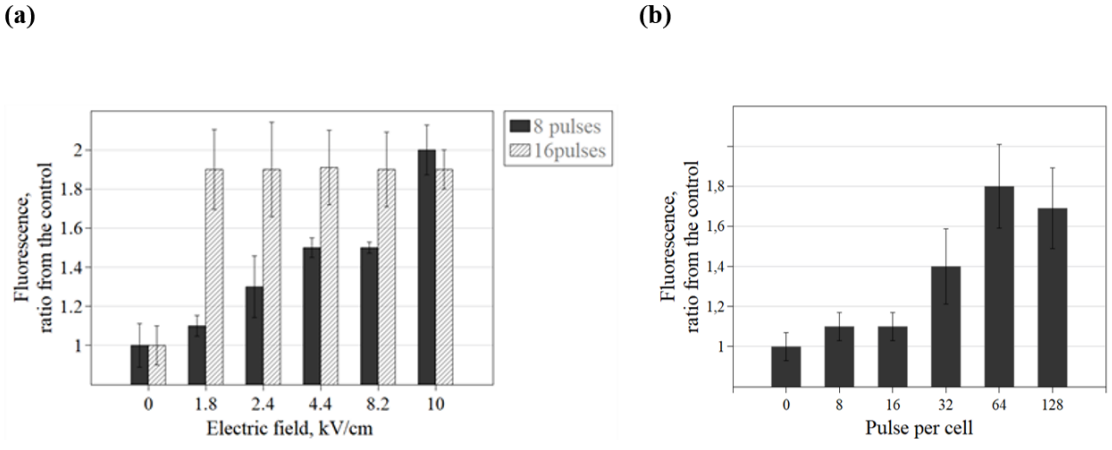

Fig. 2. Permeability to DAPI after (a) stop-flow electroporation with different electric fields, 8 or 16 pulses, and (b) continuous flow electroporation with the electric field of 1.8 kV/cm. In (a) and (b) electroporation is performed with 100 μs pulse length and 1 Hz frequency. Fluorescence is expressed as ratio from the non-electroporated control. Error bars show standard deviation.

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