

Introducing CythorLab™ and Intelligent Electroporation

Traditional Electroporation

Traditional electroporation always involves a certain amount of trial and error. This is expensive and time consuming but may be acceptable for in vitro use of the method. For clinical applications and in most experimental in vivo applications this is not only expensive and time consuming but unacceptable.

Electroporation, or in some literature electroporabilization, is a method using brief and intense electric pulses to create small pathways (pores) in the membrane of the cells. Before electroporation, non-permanent molecules are rejected by the membrane (figure 1A). After electroporation the pores enable large extra cellular molecules such as e.g. injected DNA, anti-cancer drugs or vaccines to transfer into the cytoplasm or nucleus of the cell (figure 1B).

The induction of pores in the cell membrane depends mainly on three parameters:

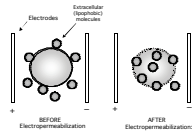


Fig. 1A & 1B: The principle of electroporabilization

1. Different types of cells show different sensitivity to electric fields.
2. The product of pulse amplitude and pulse duration combined with other electric properties has to reach a certain threshold value in order to create pores. A cell to cell variability is found depending on their different sensitivity as mentioned above.
3. If the product of amplitude and pulse duration is too high the electroporation becomes irreversible and the cells will die.

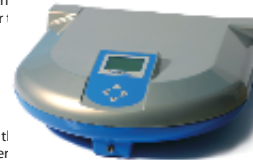
Intelligent Electroporation

Intelligent Electroporation is a unique and patented method combining Traditional Electroporation with Impedance Spectroscopy. The method as introduced in CythorLab™, is a powerful tool in experimental electroporation and a prerequisite for future clinical in vivo applications.

The correct choice of pulse parameters like shape, amplitude, frequency and interval between pulses are crucial for an efficient electroporation. Therefore there is a great need for a method to verify and control the degree of electroporation after each pulse in order to optimize the outcome of the treatment.

The patented CythorLab handles these aspects by using a computerised arbitrary pulse generator that is able to design, in principle, any pulse form or pulse train.

CythorLab's pulse generator in combination with its built-in impedance spectrometer makes it possible to refine and optimize the pulse protocols governing the optimal efficiency in intra cell delivery of DNA, chemotherapeutic drugs and vaccine.



The future in non-viral drug and gene delivery

Impedance Spectroscopy

Using a range of AC frequencies, impedance spectroscopy makes it possible to measure, quantitatively in real time, the degree of electroporation obtained.

Living tissue is composed of cells, which are surrounded by a highly electrically insulating lipid membrane. Between the cells, there is an extra cellular liquid compartment of high electric conductivity. Electrical DC and low frequency currents are limited to the extra cellular space.

With increasing AC frequency the impedance of the cell membrane decreases. Electrical impedance readings over a frequency range allow separation of extra cellular space and of the membrane themselves.

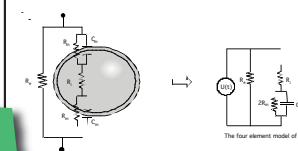


Fig 2A & 2B: Equivalent circuit of a cell in an electric field