# "Cell Electrofusion in Microchips: Optimization of Fusion Efficiency"

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Since more than two decades, cell-cell fusion has been carried out in vitro with the use of biotech methods, chemicals, optics and electronics. The principal motivation of cell fusion is the creation of hybridomas for the production of monoclonal antibodies for immunological related diseases.

Electrofusion of cells is achieved in two main steps. First, cells of interest have to be brought into close contact with the help of dielectrophoretic forces created by high-frequency and low-voltage signals. The second step is to initiate fusion based on electroporation by applying short and high electrical fields.

Cell electrofusion is nowadays being studied at the single-cell level in microfluidic chips. This enables to lower the quantities of cells and media and to work with lower voltages.

The present project has been carried out at Fraunhofer Institute for Biomedical Engineering IBMT where the electrofusion process is successfully achieved (see figure A).

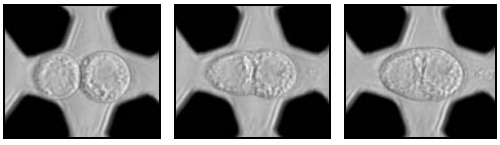

*Fig. A: Fusion between two P3X cells.*

The goal of this master project was to optimize the fusion pulse parameters in order to get a gentle and reproducible fusion. The experiments showed low fusion reproducibility and five different cell behaviours given the same electrical field was applied (see figure B.).

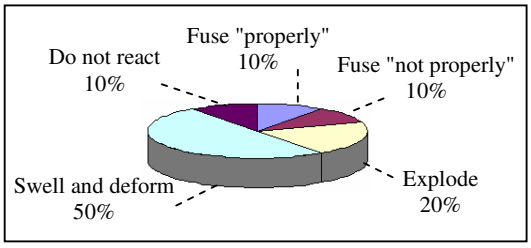


*Fig. B: Cell pair behaviours and appearance percentages*

Given this low reproducibility, all the fusion parameters were scanned and checked in order to understand their entire role during fusion. Among these parameters, only the cell cycle and the parameters inside the chip were not fully controlled. The project focused on an electrical method, via impedance measurements, to measure the conductivity in the chip. Once the calibrations were done, conductivity variations inside the chip during the fusions were analysed. The results showed a slight conductivity variation in the vicinity of the electrodes but no correlation between the fusion efficiency and the conductivity variations. Besides that, tests of cell viability in fusion buffer showed a dramatically low cell survival after 30 minutes of incubation (see figure C).

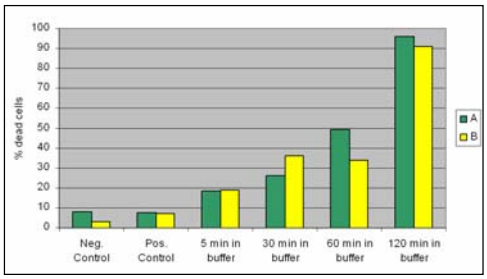


*Fig C: P3X cell survival in buffer, 24 hours after exposure*

Taking into account the obtained results, a new chip fluidic was designed in order to keep the cells as short as possible in fusion buffer. Finally, 3D simulations of the electrical field in the fusion cage were achieved in order to understand the position and the poration process of cells (see figures D and E). Besides that, a trapping and a fusion signal configuration for a new electrode cage was proposed.

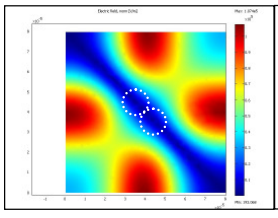

*Fig D: Elec. field: position of cells*

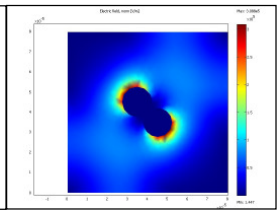

*Fig. E: Elec. field: poration of cells*