

Fully automated microinjection system: from sorting, singularizing, injecting, to collecting

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Microinjection is still one of the most effective transfection methods in terms of cell damage and cell viability. However, it suffers from a small throughput and large variations in success rates due to poor reproducibility. Furthermore, sorting, placing and collecting are still tedious manual procedures performed by highly skilled personnel. To overcome these drawbacks, CSEM developed a special cell sorter and novel injection system for *Xenopus laevis* oocytes or any other biological entity in suspension with a size range from 500 to 1500 microns. The complete system enables to minimize manual interaction to simply providing a suspension of cells and a loaded microinjection needle. The system then automatically performs the sorting and individualization of cells, microinjection, and collection of microinjected cells in a separate container for subsequent processing. The novel cell sorter is designed to work in continuous mode, meaning the cells pass the detection system several times before being ejected into the next module. This method allows a much higher sorting success rate than in common flow cytometers where each cell passes the detector only once. Additionally, the constant circulation of the cells in the sorter, avoids cell adhesion to the device surfaces. The cell sorter can handle opaque as well as transparent or fluorescently labeled cells, because it uses two oppositely placed vision sensors and the customized vision algorithms for selection. The sorter ejects cells on demand into the injection system, which is based on a carousel principle, allowing to immobilize, inject, and collect three cells simultaneously at three respective positions. The complete process, including sorting, immobilizing, injecting, and collecting a cell, is currently performed within 4 seconds. Using this automated microinjection system enables to prepare a typical batch of 400 microinjected cells in less than 30 minutes. Compared to the two days of the manual approach, this 32-fold increase of speed will enable researchers to concentrate on the characterization phase of their experiments and to increase the statistical value of their results.

Figure 1, (left) bottles for buffer source and waste, (middle) sorting and injection system, (right) pressure system and computer

