Spanish breakthrough allows electroporation of cell cultures for less than one Euro

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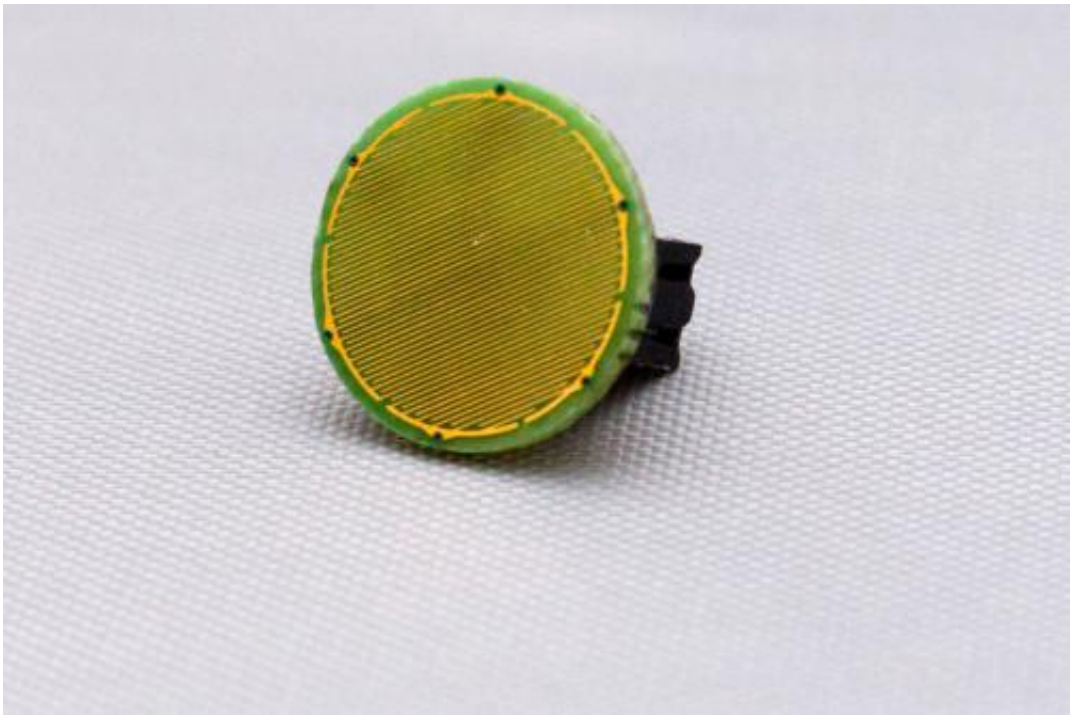

The plate for performing electroporation has the shape of a disk and it is a little smaller than a 20 cent coin. Credit: UPC

Researchers from the Polytechnic University of Catalonia have developed a technique that improves and cuts the cost of a technique called electroporation, which involves opening pores in cell membranes using an electric field to introduce substances like drugs and DNA. Current methods are aggressive and expensive whereas the new system

manages to apply low voltage electroporation with a small printed circuit board, which costs less than a Euro per unit and does not damage cells.

Two US firms in Boston and San Francisco operating in the biotechnology equipment sector have already expressed their interest in the new system for the electroporation of cell cultures developed and patented by researchers at the Biomedical Engineering Research Centre (CREB) of the Polytechnic University of Catalonia (UPC).

Electroporation consists of opening the pores in the cell membranes using an external electric field to insert certain substances such as drugs, DNA and RNA. It is used for example in gene therapies and molecular biology experimentation. "Until now, its use has been rather restricted because current systems are expensive and awkward," as explained to SINC by the researcher Ramón Bragós who undertook this project along with PhD student Tomás García-Sánchez.

Different electroporation techniques are used for example in the process of inserting exogenous nucleic acids into eukaryotic cells. This process is called transfection and in 2012 it generated a global turnover of 650 million euros, according to data from the UPC.

Bragós outlines that the electroporation system developed by the UPC simplifies that process and reduces many of the costs compared to techniques being used at present. This makes its use in research easier.

The UPC's system can be applied in the electroporation of mammal cell cultures. As the researcher explains, in this case cells grow adherent to the bottom of plates. "These cells are 'accustomed' to being in a tissue, in a compact environment where they touch their neighbours. When they are cultivated they stick to the bottom and grow until they come in contact with other cells thus forming a monolayer," adds the researcher.

Avoiding cell stress

According to Bragós, the electroporation method used up to now is very aggressive. Firstly, an enzyme must be added to detach the cells adhered to the bottom of the culture plate. Then they must be transferred to a special cuvette with electrodes where the electrical discharge is applied. Lastly, the cells must then be returned to the plate. All this combined causes stress in the cells and only a fraction survives. This translates into significant losses.

"We have developed a small plate in the shape of a disk. In its lower face it contains a collection of electrodes that allow for high output electroporation. The devices are made to match the size of the plate containing the cultures, the most common being a centimetre in diameter."

Ramón Bragós explains that the added value of the device is that it allows the electroporation in the recipient in which cell culture is already taking place without the need for them to be extracted. This usually occurs in Petri dishes or multiwell plates. The device incorporates microseparations that ensure that the disk is situated some 10 microns apart. Therefore, without touching or crushing the cells the discharge is performed under 20 volts and then removed.

"We initially thought of developing a device with microelectronic technology but we managed to do it with printed circuit technology, which is much cheaper. Each disk ends up costing less than one Euro per unit, which is very competitive compared to current devices that go from one Euro to 100 euros per unit," points out the researcher.

In addition, Bragós points out that the low cost of the new devices means that laboratories can use them on a single use basis. This eliminates culture contamination problems.

The technique is also safer for those carrying out the experiments thanks to its low discharge of less than 20 volts compared to conventional techniques that can use up to hundreds or even thousands of volts, according to the researcher.

This project was financed through Catalonia's Technology Assessment Support Programme of the Generalitat's Agencia ACC1Ó.

In addition, the initiative enjoyed the active participation of the group lead by Dr Anna Maria Gómez-Foix from the Department of Biochemistry and Molecular Biology of the University of Barcelona.

Experimentation with small RNA fragments

The PhD student Tomás García-Sánchez has played a fundamental role in developing the new technique applied to the UPC's electroporation of cultures and is currently writing his thesis on this project.

García-Sánchez explains to SINC that during the process of developing the new system they experimented with a transfection technique based on inserting small RNA fragments into the siRNA (small interfering RNA) culture cells. The main function of these fragments is to block specific gene expression once inserted into the cellular cytoplasm.

"The possible gene therapy with siRNA is on the rise in the world of biomedical research nowadays with its application in antiviral therapies and neurodegenerative illnesses, for example," indicates the researcher.

"The fact that we have managed to simplify and make the electroporation process cheaper has opened the door for molecular biology researchers to access a technique with many prospects," he concludes.

More information: García-Sánchez, T. et al. Design and Implementation of a Microelectrode Assembly for Use on Noncontact In Situ Electroporation of Adherent Cells. *Journal of Membrane Biology*. 2012; 245(10):617-24. DOI 10.1007/s00232-012-9474-y

García-Sánchez, T. et al. Automatic system for electroporation of adherent cells growing in standard multi-well plates. *34th Annual International Conference of the IEEE EMBS*. San Diego, California EE UU. 2012

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