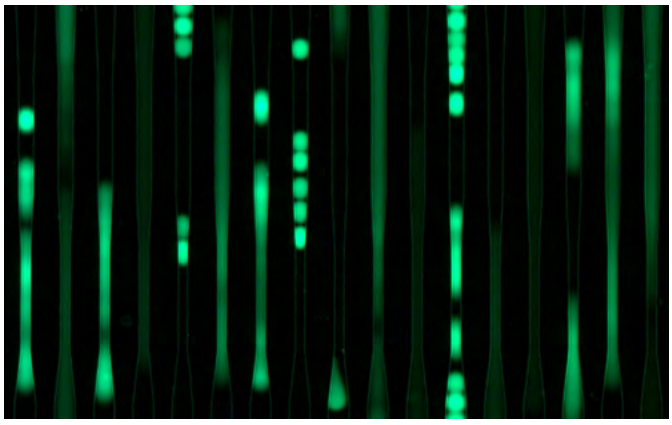
MAX-PLANCK-ZENTRUM
FÜR PHYSIK UND MEDIZIN
Ein gemeinsames Forschungszentrum mit der
FAU und dem Universitätsklinikum Erlangen

Efficiently smuggling drugs into cells

A new, patented method called Progressive Mechanoporation makes it possible to mechanically disrupt the membranes of cells for a short time period and let drugs or genes inside cells. In this way, researchers can test new therapies more easily than before.

Modern vaccines such as those against Sars-CoV-2 use tiny lipid spheres to transport genetic information into cells and let the body build up an immune defense against the virus. A team of scientists from Erlangen, Dresden, and London has now developed a completely new method to very efficiently deliver not only genes but also drugs and other substances into cells. The researchers from the Max-Planck-Zentrum für Physik und Medizin (MPZPM) in Erlangen, the Technical University of Dresden, and The Institute of Cancer Research in London have named the method Progressive Mechanoporation and have now published it in the scientific journal "Lab on a Chip". They have also filed a patent.

Ruchi Goswami and Alena Uvizl were part of a team of scientists led by Salvatore Girardo (Erlangen) and Jörg Mansfeld (Dresden/London) who have developed the Progressive Mechanoporation. They have built a special polymer biochip that contains a series of microchannels. Each microchannel is narrower than the previous one, finally reaching a size more than ten times thinner than a human hair. The scientists pass the cells through these channels, causing the cells to stretch more and more. The stretching creates pores in their cell membrane, allowing molecules to pass through these pores and get inside the cells. Once the cells have passed through the channels, the pores close again. The scientists demonstrated that Progressive Mechanoporation can deliver even very large proteins inside the cells. As a proof of concept the scientists used antibodies and CRISPR/Cas9, the genetic scissors whose discovery led to a last year's Nobel Prize.



© MPZPM, Salvatore Girardo

Fluorescent soft beads passing through the narrowing channels of a biochip

Potentially a new routine procedure for hospitals

"The big advantage of our method is that we can pass up to 10,000 cells per second through the chip," explains Salvatore Girardo, leader of the technology development and service group Lab-on-a-Chip at the MPZPM. At the same time, the method is very gentle. Compared to other techniques, very few cells get damaged.

The Progressive Mechanoporation method could be used in drug development and allow pharmaceutical companies to

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efficiently test new molecule candidates. In addition, the process can be easily automated. Jörg Mansfeld, a research group leader at the Biotechnology Center (BIOTEC) of TU Dresden and at The Institute of Cancer Research, London, adds: "I can envision that in the future, hospitals will be able to routinely examine and even treat patients' cells using Progressive Mechanoporation."

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The cells are stretched by passing through the nanochip. This creates pores in their cell membrane, allowing molecules to pass through and get inside the cells

About the Max-Planck-Zentrum für Physik und Medizin (MPZPM)

The Max-Planck-Zentrum für Physik und Medizin (MPZPM) is conceived as a joint effort between the Max Planck Institute for the Science of Light (MPL), the Friedrich Alexander University (FAU) and the FAU University Hospital in Erlangen. The new scientific center aims to apply advanced methods from experimental physics and mathematics to basic biomedical research with an emphasis on the intercellular microenvironment.

About the Biotechnology Center (BIOTEC)

The Biotechnology Center (BIOTEC) was founded in 2000 as a central scientific unit of the TU Dresden with the goal of combining modern approaches in molecular and cell biology with the traditionally strong engineering in Dresden. Since 2016, the BIOTEC is part of the central scientific unit "Center for Molecular and Cellular Bioengineering" (CMCB) of the TU Dresden. The BIOTEC is fostering developments in research and teaching within the Molecular Bioengineering research field and combines approaches in cell biology, biophysics and bioinformatics. It plays a central role within the research priority area Health Sciences, Biomedicine and Bioengineering of the TU Dresden.

About The Institute of Cancer Research (ICR)

The Institute of Cancer Research, London, is one of the world's most influential cancer research organisations. Scientists and clinicians at The Institute of Cancer Research (ICR) are working every day to make a real impact on cancer patients' lives. Through its unique partnership with The Royal Marsden NHS Foundation Trust and 'bench-to-bedside' approach, the ICR is able to create and deliver results in a way that other institutions cannot. Together the two organisations are rated in the top four centres for cancer research and treatment globally. The ICR has an outstanding record of achievement dating back more than 100 years. It provided the first convincing evidence that DNA damage is the basic cause of cancer, laying the foundation for the now universally accepted idea that cancer is a genetic disease. Today it is a world leader at identifying cancer-related genes and discovering new targeted drugs for personalised cancer treatment. A college of the University of London, the ICR is the UK's top-ranked academic institution for research quality, and provides postgraduate higher education of international distinction. It has charitable status and relies on support from partner organisations, charities and the general public. The ICR's mission is to make the discoveries that defeat cancer.

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