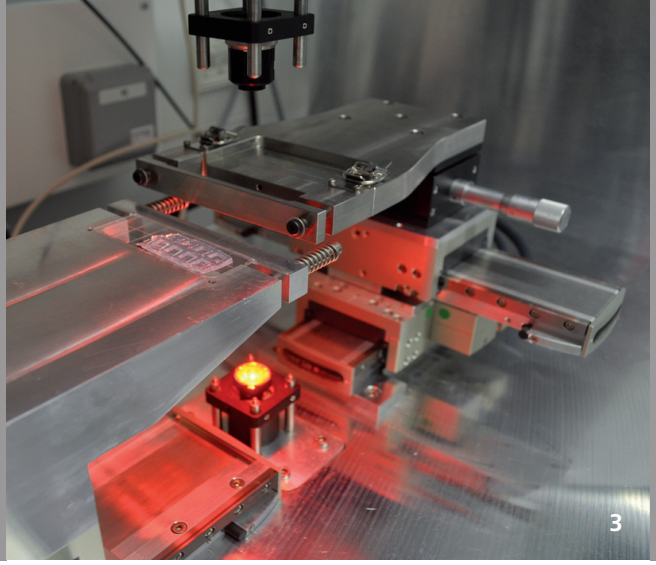

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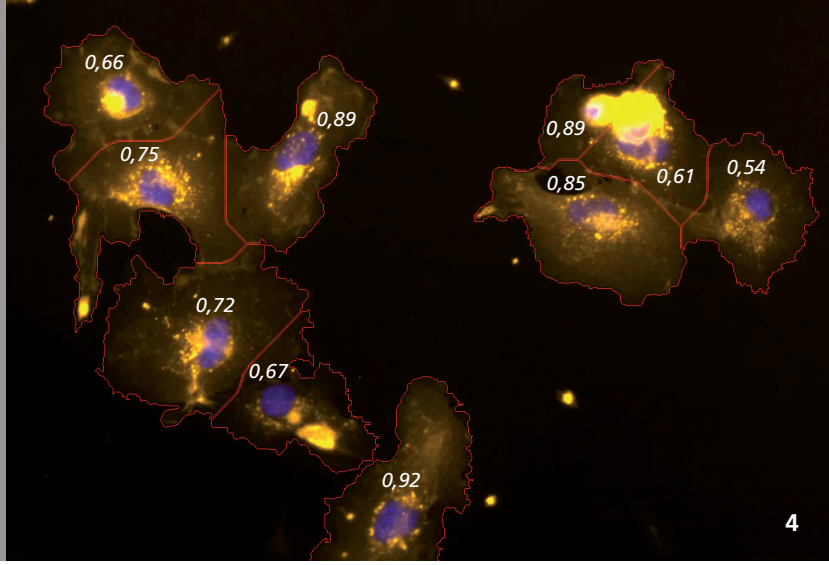

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CELL PRINTING AND AUTOMATED CELL IMAGING

Task

The use of stem cells is becoming increasingly important in medicine. Researchers are looking for ways of generating skin cells, hematopoietic cells and, in the future, entire organs from stem cells. As part of a cooperation project between the Max Planck Society and Fraunhofer, research is being done into the necessary conditions for differentiating hematopoietic stem cells on the basis of multilayer three-dimensional stem cell systems. For the realization of such artificial stem cell niches a building technology is necessary, one which enables a highly defined and reproducible printing of the cell types of interest. In addition to precise cell positioning, Fraunhofer ILT's task also includes the automated analysis of cell ensembles. In particular, the tracking of the cell boundaries is one of the most required pieces of information for the biologists.

Method

Laser Induced Forward Transfer (LIFT) is a versatile technology that can fulfill the above challenges. During LIFT, cells can be transferred from a transfer slide onto a receiver slide. Highly resolved microscopic images will be taken from the stem cell assays built up artificially by the LIFT technology. These images are then analyzed automatically with the help of dedicated image processing algorithms. The combined analysis of fluorescent images as well as bright field images will enhance the detection result of the designed algorithms.

Result

The Fraunhofer ILT has developed a LIFT-Tool (LIFTSYS) that enables scientists to select cells using a camera based system and thereafter to transfer them onto a receiver. These cells can be transferred into a 3D matrix and used for cell-based in vitro assays. Initial experiments show that HEK 293 cells can be positioned by LIFTSYS. For the automated detection of cell boundaries, first results could be achieved using bright field images as well as fluorescent images. One challenge still remains in distinguishing adjacent cells. Only with the help of fluorescently labelled cell nuclei could the cell differentiation be completed.

Applications

With the help of high precision cell positioning in 3D cell assays and the automated tracking of the cell boundaries, in-vitro test systems can be built and analysed. The insights gained will help to explain the processes that play an important role within the stem cell niches and, thus, promote the use of in-vitro stem cell niches in developing drugs over the long term, e.g. the development of new leukaemia drugs.

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3 Handling system of the LIFT Tool.
4 Detection of cell boundaries. (source: Max-Planck-Institut für molekulare Biomedizin, Münster).