



NEW HYDROGELS FOR LASER-BASED PRINTING OF FABRIC MODELS

Task

Laser-assisted bioprinting (LAB) is based on the process of laser-induced forward transfer (LIFT). To print with single cells or clusters of cells, a hydrogel is needed, which absorbs the laser radiation, forms a uniform, stable layer of constant thickness and is biocompatible. Up to now, 5 percent gelatin has been used for single cell printing, but this has proved unsuitable for printing cell clusters at temperatures around 37 °C and increased humidity. Therefore, a new hydrogel needed to be established.

Method

LAB is currently being tested with a MIR beam source at a wavelength of 2.94 µm and a hydrogel that consists of more than 95 percent water. Water serves as absorption medium for the LIFT process. Typically used for cell cultures, the hydrogel Matrigel® was diluted with cell culture medium according to the manufacturer's instructions, a step that makes it possible to apply gel layers with a thickness < 100 µm. The gel crosslinks at approximately 37 °C. Fraunhofer ILT investigated how uniformly the hydrogel as well as living cells could be transferred in the semi-automated LIFTSYS® system under climate-controlled conditions.

- 1 Layer thickness measurement of a hydrogel layer.
- 2 Overview of a printed image of four fields of five times ten drops each.

Results

Thanks to Matrigel®, the institute could demonstrate that drop patterns could be printed uniformly for the first time and at a success rate of more than 95 percent. The transfer efficiency is thus about 30 percent higher than with gelatin. Fraunhofer ILT also demonstrated that cell clusters can be successfully transferred using Matrigel®.

Applications

The use of Matrigel® as a hydrogel opens up new fields of application for LAB in 4D bioprinting since cell clusters can be printed, thus promoting advances in tissue engineering. The construction of organoid structures and the development of organ-on-a-chip systems, for example, are of great interest for pharmaceutical research. Matrigel® as a transfer layer for LAB is particularly suitable for processing demanding cell types such as stem cells or cardiomyocytes. The overarching, visionary goal is to develop cardiovascular implants and artificial organs.

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