Next-Gen Life Science Automation

Organs-on-a-Chip for Pharmaceutical Development

FESTO

Automation for a world in motion.

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Organs-on-a-Chip for Pharmaceutical Development

As part of its Next-Gen Life Science Automation, Festo is researching new solutions for medical technology and laboratory automation. The exhibit demonstrates the automated production of organs-on-a-chip (OoC), where a bioprinter prints human cellular material on a microfluidic chip. This cellular material can then be cultivated into organ-like tissue. In pharmaceutical testing, organs-on-a-chip can significantly reduce the time taken for drugs to gain marketing authorization. Here, Festo is combining two cutting-edge technologies for the first time: SupraMotion and Diffusion Bonded Manifolds.

The microfluidic chip: a Diffusion Bonded Manifold with precise channel structures

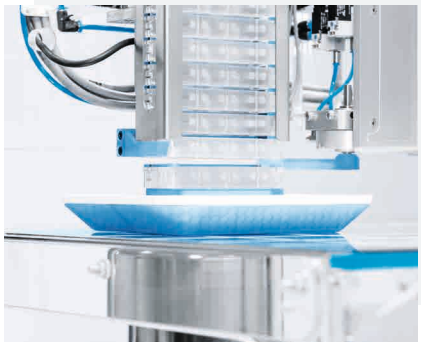
In the fight against diseases, medical researchers are continuously looking for new medicines, which usually take a long time and are very expensive to develop.

First, a drug candidate undergoes multiple preclinical studies in cell cultures (in vitro) or animals (in vivo). Then, in the final stage before marketing authorization, the drug candidate is tested in humans. On average, five drug candidates are tested for each medicine, four of which ultimately fail.

The reason for this is that the results of preclinical studies often do not translate well to the human organism.

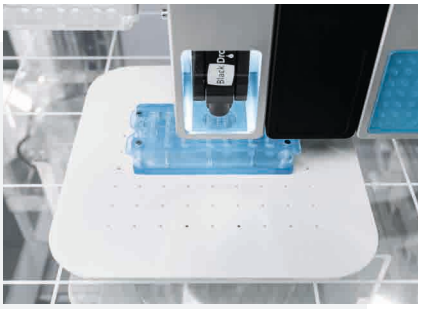
Much better results can be achieved with mini-organs from a bioprinter – organs-on-a-chip. On these small pieces of human tissue on a microfluidic chip, drug effectiveness and side effects can be tested with more precision in preclinical studies. Unsuitable candidates are discontinued at a significantly earlier stage, which saves time and money and allows faster and more cost-effective development of new drugs.

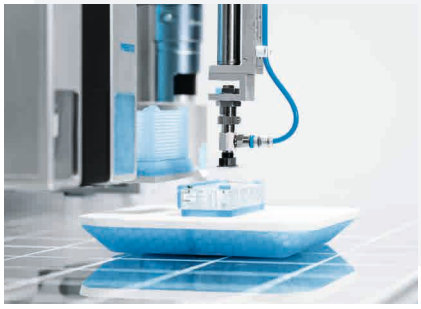
Festo, together with experts from the Technical University of Darmstadt, demonstrates how the bioprinting process can be automated – including a solution for contactless transport of microfluidic chips which feature Bonded Manifold technology.



Contactless Transport with SupraMotion
The microfluidic chip is placed on a levitating carrier in the SupraMotion system. Electric axes beneath the base surface move the cryostat and, with it, the levitating carrier above from station to station. It is transported through walls without contact or particle carryover, which is a major advantage for hygiene and cleaning.

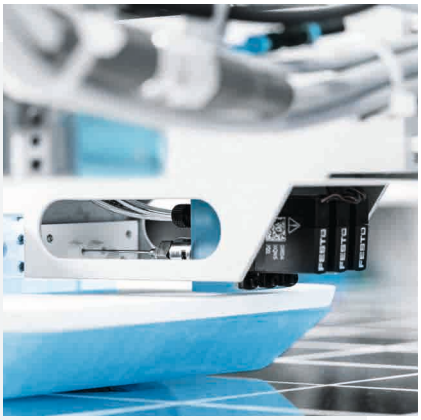
Bioprinter and UV Treatment
Using drop-on-demand technology, the bioprinter prints tiny droplets of living cells embedded in hydrogel directly onto the microfluidic chip. Then, the material is UV-crosslinked so that it can be processed further.





Covering the Microfluidic Chip
To create a closed microfluidic system, the exposed channels and chamber with the printed cells are covered with a silicone-coated glass plate.

Loading the Nutrient Medium
Three cannulas penetrate the microfluidic chip through a silicone membrane. One of them applies negative pressure to hold the glass plate in position, which ensures that the channels are securely sealed. The two other cannulas are used to load the nutrient medium in which the cells can grow. The needles are then withdrawn, and the punctures close by themselves thanks to the membrane. The cells can now be transported and stored in safe, sterile conditions for the next process steps in the incubator.



Festo – Your Automation Partner for Life Sciences
With its flexible automation solutions, Festo supports the translation of innovative therapies into clinical practice and provides cutting-edge biotechnology right where it is needed. We offer an extensive catalog portfolio and also develop customer-specific solutions for laboratories, diagnostic applications, and bioprocess applications, ranging from precise fluid and gas dosing to scalable, modular systems. With our portfolio of pneumatic, electrical, software, and AI products, we work together with customers to achieve the perfect, seamless automation solution.
www.festo.com/lifetech

Project Participants

Project Initiators: Dr. Wilfried Stoll, Managing Partner, Festo Holding GmbH
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Prof. Dr.-Ing. Andreas Blaeser, TU Darmstadt
Moritz Ellenberger, Leon Roß, Black Drop Biodrucker GmbH

Integrated Technologies and Products

- **Diffusion Bonded Manifold**
  fluidic solution with high functional integration for securely distributing the nutrient medium
- **SupraModule**
  for transporting the microfluidic chip without contact
- **Control unit CEPE**
  for controlling the tracks and axis system in the exhibit
- **Pressure vacuum generator PGVA**
  for optionally supplying decentralized compressed air for the printing process
- **Media-separated solenoid valve VYKA**
  for dosing the nutrient medium with high precision
- **Electrical axis ELGD**
  for precisely moving and positioning the SupraModule
- **Servo drive controllers CMMT-AS and CMMT-ST**
  space-optimized servo drive controllers for operating the stepper motors
- **Festo Motion Package**
  simple and intuitive programming in Festo Teach Language (FTL)

SupraMotion: Contactless Processes in the Laboratory of the Future

Using the unique superconductor technology from Festo, objects can be transported without contact. The kinematic system remains outside of the clean room and prevents particle carryover. The equipment has smooth surfaces which are easy to clean. The innovative technology can be combined with life science automation solutions to form a comprehensive solution which ensures a reliable process and meets the most demanding cleaning and hygiene requirements.

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