



LABBAG® – LABORATORY IN THE BAG

Human stem cells are considered as a new hope in personalized medicine. In the future, they should be used for example in the treatment of neuro-degenerative diseases. In a joint project coordinated by the Fraunhofer IST together with the Fraunhofer Institutes IBMT and IVV a closed surface-based cultivation system has been developed. By using the so-called LabBag® these cells can be cost-effectively, quickly, and aseptically cultivated, differentiated and cryopreserved.

Cultivation of stem cells

Scientists all around the world are trying to identify the potential of human stem cells to defend previously incurable diseases or are using these cells to perform fundamentally research on various diseases. For this the availability of high-quality, three-dimensional cellular material is indispensable, since these types of systems reflect much more effectively the conditions in the organism, than the previously used two-dimensional cell cultures. For cultivation of 3D aggregates the “hanging droplets” method is used. So far, cell aggregates of stem cells were generated either by pipetting robots, for which acquisition and maintenance are extremely expensive, or through manual pipetting. The latter is work- and time-intensive, requires a lot of practice, and involves a high risk of contamination.

In order to execute this process more cost-effectively and above all aseptically, the Fraunhofer Institute for Biomedical Engineering IBMT, the Fraunhofer Institute for Surface Engineering and Thin Films IST, and the Fraunhofer Institute for Process Engineering and Packaging IVV have come together and developed the LabBag®. In this mini-laboratory human induced pluripotent stem cells (hiPSC) can be cultivated in hanging droplets in a sterile environment to form 3D aggregates.

Coating for formation of hanging droplets

The coating on the inside of the bag developed at the Fraunhofer IST is crucial for the formation of the hanging droplets. This coating is applied by an atmospheric pressure plasma coating process and consists of a multiple layer system. By an initial coating, the internal surface becomes super hydrophobic and also repellent relative to the cell culture medium. In a second coating step hydrophilic spots are arranged on this surface, so that the cell culture medium is concentrated in these spots. In this manner several hundred hanging droplets are generated in the closed bag within a few seconds by simply shaking the bag. The cells sink into the droplets and within 72 hours form the desired 3D cell aggregates.

Advantages of the LabBag®

The coating procedure by an atmospheric pressure plasma process is a dry process, so that no solvents are used in the process. This is a great advantage, as residues of the solvent might influence cell viability. The desired layer properties can be adjusted by the used process gases and the film-forming agents so that an optimized surface for the formation of the hanging droplets occurs.

1 *LabBag® – a closed mini-laboratory for 3D cell cultivation.*

2 *Hanging droplets for the formation of 3D cell models.*

Further advantages of the LabBag® are:

- | Lower personnel and material costs
- | Increased cell yield and process reliability
- | Easy adjustment of the droplet volume and thus the aggregate sizes by variation of the deposited spot diameters on the bag surface
- | Cryo-conservation of the cells within the LabBag®

Outlook

Further developments and future applications for the LabBag® are:

- | Integration of sensors for cell monitoring
- | Generation of additional layer functions within the bag
- | Further development of the LabBag®, e.g. for the use in veterinary medicine
- | Optimization of the LabBag® for medication screening in the development of pharmaceutical products

The project

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CONTACT

Dr. Michael Thomas

Phone +49 531 2155-525

michael.thomas@ist.fraunhofer.de

Dr. Kristina Lachmann

Phone +49 531 2155-683

kristina.lachmann@ist.fraunhofer.de