GESIM

Microfluidic Workstation
Customizable Platform for:
In-vitro 3D Tissue Engineering, Microfluidic Multi-Cell Cultivation, Single Cell Handling, Liquid Handling/ Microarraying

Introduction

The **Microfluidic Workstation** is a modular robotic tool kit for research projects with transparent microfluidic chips/ cartridges. The work deck of the instrument has three large recesses for customizable trays. They adapt standard glass slides, SBS format objects as well as non-standard customized targets.

The Microfluidic Workstation features two tool heads for material handling and optical measurements. The instrument offers full 3D printing including import of external CAD models.

Tools for material handling:

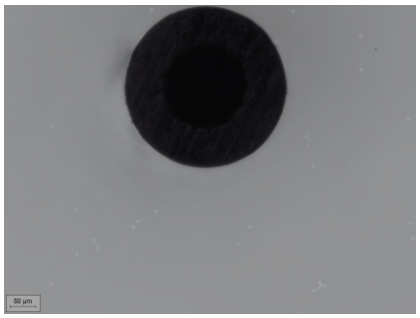
- Disposable pipets with automatic replacement,
- Piezoelectric Nanolitre Pipets with wash system,
- Nanolitre drop mixing in real time,
- Vial and tube handling (automatically),
- Pneumatic/piezoelectric extrusion of high-viscous materials,
- Powder pipet for Micrograms,
- Cameras for observation and alignment,
- UV-lamp head

The benchtop workstation fits into many biosafety cabinets. It comes with external CPU incl. media supply (Not shown). Cabinets with black screens are also available.

The measurement camera can be configured to different detection methods, e.g. fluorescence microscopy, phase contrast microscopy and turbidity measurement for ELISA.

*CeCuLab (see back side), a special setup of the **Microfluidic Workstation**. The smaller box (left) is an independent media control unit for the MOCs on the left tray.*

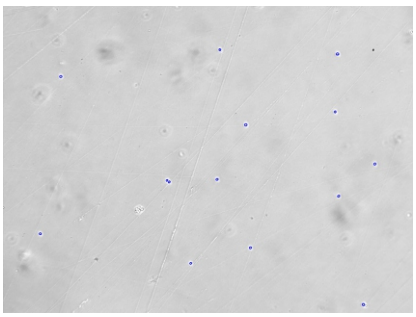
Imaging Systems for the Microfluidic Workstation



Yest cells in a SBS well plate - bottom view. The picking capillary orifice is at the upper edge.

The Microfluidic Workstation operates alignment cameras on the upper tool head as well as measurement microscopes on the lower tool head.

These pictures are phase contrast images gathered by a compact microscope with 400-fold magnification.



The software of the MW recognizes single cells, differentiating from optical artefacts.

This product is under constant development. Please visit us again in a while:

https://gesim-bioinstruments-microfluidics.com/microfluidics/

Microfluidic Workstation

Microscopy, Pipetting, Lab-on-a-Chip, Single Cell Handling

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Cell-Culture-Lab (CeCuLab)

CeCuLab (Prototype), based on the Microfluidic Workstation, features Multi-Organ-Chips **(MOCs)** with embedded closed but transparent cavities for cell/ tissue growing. The MOC cavities are part of an onboard microfluidic circuit with external pumps/ valves for supply and removal of reagents, nutrition samples and gas and can be accomplished by integrated sensors.

The MOCs host cells, either in suspension or embedded into small 3D scaffolds (micro organoids).
For automatic handling the MOCs are kept at microscope slide format.
In order to interface with the robot the MOCs come with Luer fittings, penetrable septa and semipermeable membranes.

In collaboration with:

Fraunhofer IWS Dresden
Universitätsklinikum Carl Gustav Carus DIE DRESDNER.
Zentrum für Klinische Neurowissenschaften
qualitype
TSO - Thalheim Spezialoptik GmbH

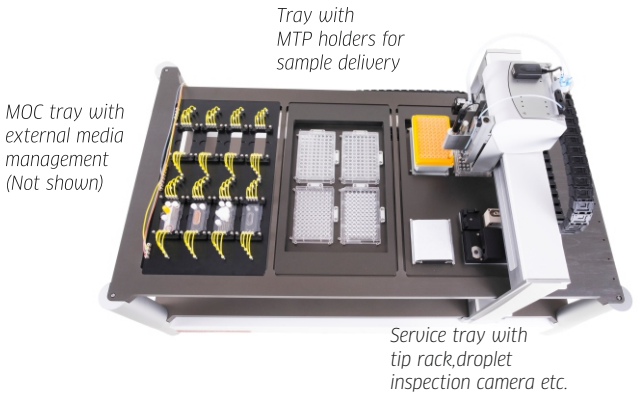
Motivation

- Unattended drug tests with autologous patient cells
- Printing of 3D scaffolds with autologous patient cells
- Most of intoxications are systemic!
- Prediction of animal tests is poor!

Benefits

- Closed micro-circulation systems reflect nature better than steady-state macro vessels
- Low media-to-cells ratio means lower dilution
- Pulsatile fluid flow within physiological ranges
- Complex unattended assays with reduced human-resource allocation

CeCuLab - A complex setup of the Microfluidic Workstation for Organ-on-a-Chip projects, funded by: SAB Sächsische AufbauBank *(SAB100216523)*



Twin Head for transparent microfluidic chips:

Upper tool head with up to 7 Z-axes individually moving

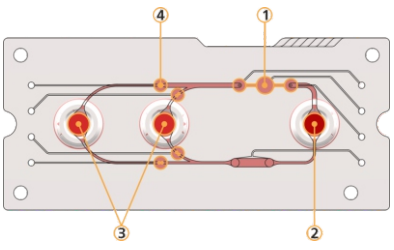
Lower tool head with optical components

Applications for CeCuLab

Each **MOC** is a unique Lab-on-a-Chip platform, customizable and built to a particular application. Oxygen is controlled directly in culture media with gas permeable membranes for in/output.

Systemic toxicity testing – A basic application

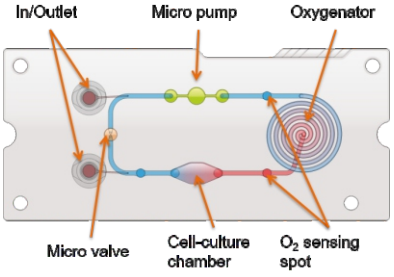
- Two parallel-connected cell culture chambers (3), reservoir (2)
- 3-point-peristaltic-pump (1), inlet and outlet valves (4)
- Temperature controlled support



Hypoxia Assay

Overcoming drawbacks of conventional Hypoxia incubators:

- Static cell culture
- High gas consumption rates
- O_2-level regulated on incubator atmosphere, not on the amount of oxygen the cells "see"



Combination of 3D bioprinting and perfusion cell culture system

- 3D printed tissue with high cell density will be maintained by perfusion
- 3D printing of biomaterials and cells direct into cell culture module
- Formation of a fluid-tight connection between tissue and cell culture module