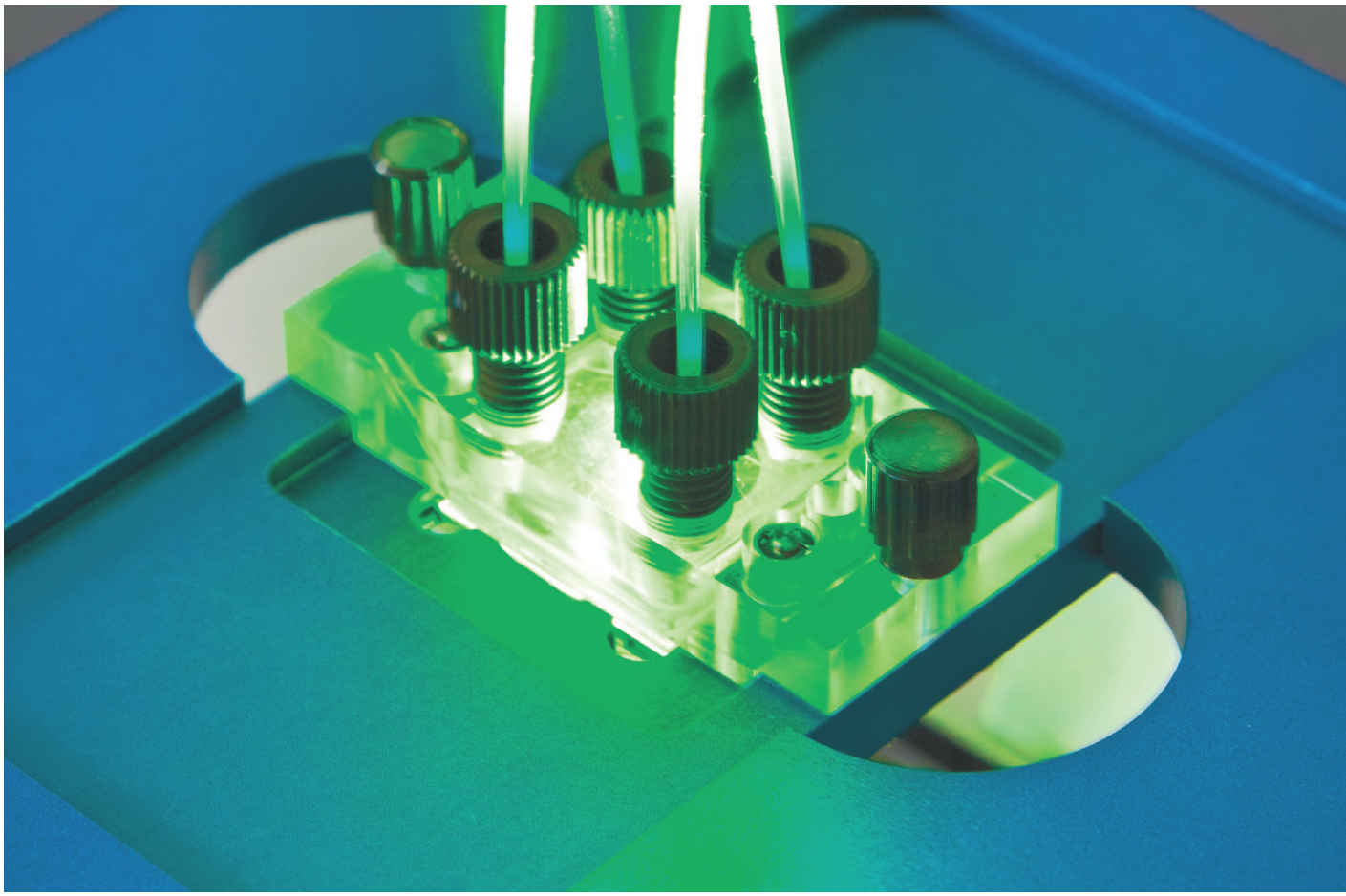
GESIM

MicCell™

Easy to Use and Modular All-Purpose Microfluidic System

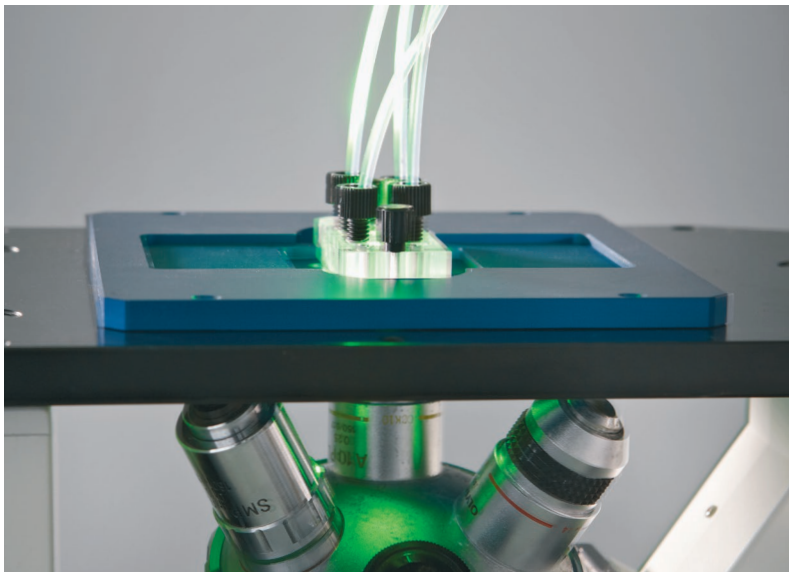


Your Complete Microfluidic Environment – From Chip to Software

MICROFLUIDICS

MIcCell Basics, Applications

- Versatile micro-flow system with standardized 'chip-to-world' interface
- Choose between soft polymer channels, glass channels and foil-based microfluidics
- Cost-effective reuse of all peripherals (pumps, valves, tubes, fittings)
- Option: all external devices in one PLC-controlled box and easy to use software with automatic tool detection



GeSiM's MicCell is a platform for quick microfluidic experiments: cast a polymer channel plate, add a coverslip, mount it in the support and put it in a microscope. It is ideal for rapid prototyping; making a new channel requires only a new silicon master that you can order from GeSiM.

You can use various other channel materials in the MicCell. Foil-based microchannel systems have gained popularity; glass and silicon channels are also possible. A version for upright microscopes is available; please inquire.

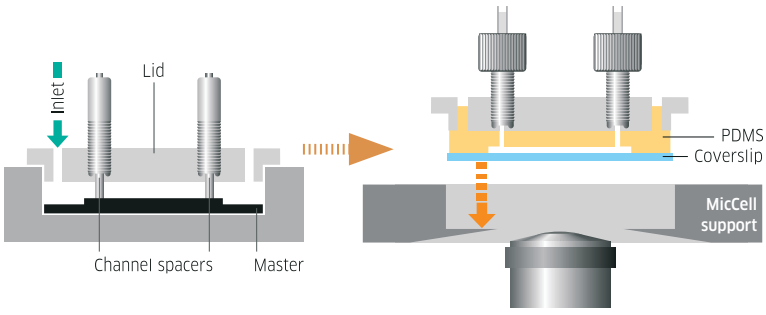
Complete the system with a ready-to-use macrofluidic environment (**GeSiM FluidProcessor**) that controls various devices such as pumps, valves, mixers, microelectrodes and many more. Process electrical signals or add optical fibres. And control everything with our freely programmable, intuitive software.

Assembly in minutes

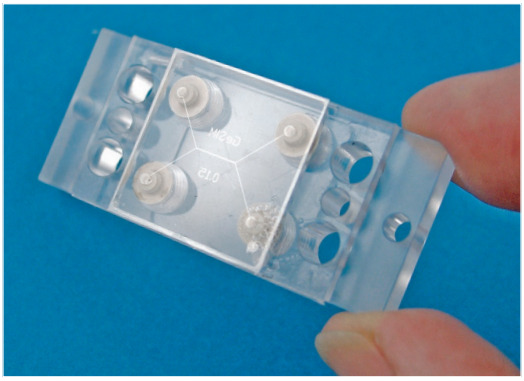
The MicCell is composed of:

- The 'Channel Plate', usually from **PDMS** (polydimethylsiloxane, 'silicone'). The moulded microchannel is closed by a coverslip; the 'Polycarbonate Body' (lid) at the top is prepared for 'chip-to-world' connections.
- The stack of channel plate and coverslip is placed in the spring-loaded MicCell support and everything is transferred to a microscope.

The simple fluidic connection of the microchannels to the outside ('chip to world') via standard fittings is ground-breaking and cost-effective. You never have to find out how to place tubes in the PDMS anymore.



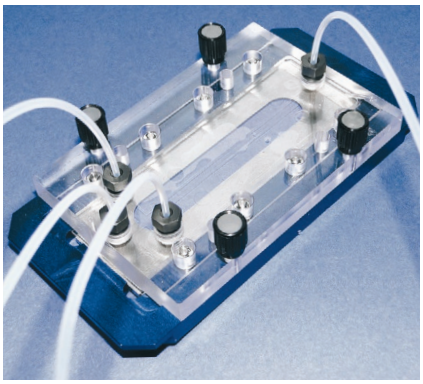
Moulding of the PDMS channel plate in the casting station (left) and mounting it in an inverted microscope (right). PDMS can be replaced by various other materials, e.g. foils.



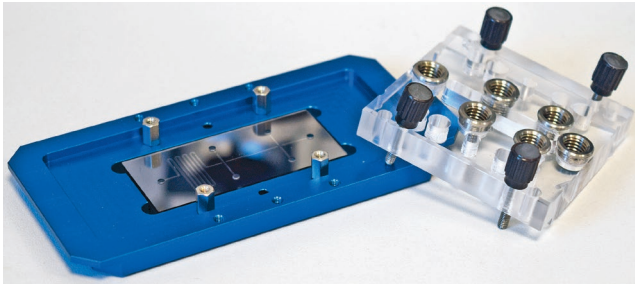
Possible applications

- Study of adherent/immobilized cells or tissue slices in laminar flow (interaction studies, viability or adhesion tests, shear stress, simulation of blood flow, electrical activity etc.)
- Experiments with suspended cells in the flow (optical tweezers, optical stretcher to measure cell rigidity, transfection)
- Bead/cell size detection and sorting
- Single-molecule detection (multi-colour fluorescence, kinetics of receptor-ligand binding and other molecular interactions etc.)
- Droplet generation / segmented flow
- Generation of hydrodynamic flow fields e.g. to study single molecules (DNA, motor proteins etc.)
- Generation of chemical gradients and applying them to cells or single molecules
- Capillary electrophoresis
- Surface plasmon resonance (SPR) or other sensor applications, with flow injection analysis (assisted by the GeSiM FluidProcessor, see last page)
- Detection of pollutants in wastewater using e.g. immobilized yeast reporter cells
- Flow cell to study the formation of biofilms on transparent and opaque anti-fouling surfaces
- Impedance measurements of cells etc.
- Development of point-of-care diagnostics

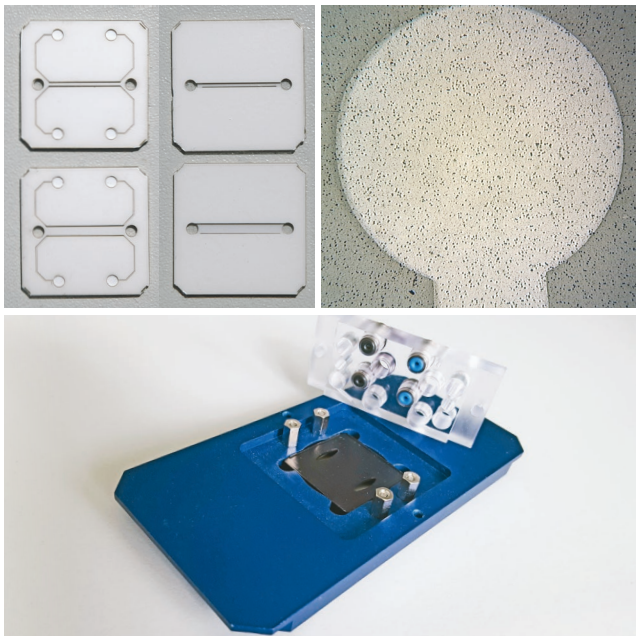
Options: Different Materials



MicCell 25 mm × 75 mm (left) and hydrogel valve on a chip in standard UNF fitting (bottom)



Silicon/glass flow cell in MicCell support and polycarbonate lid with chip-to-world interface



Foil chips, here for gradient formation, made of four foils (top left, 22×22, front/rear view) and a micropore membrane (from Oxyphen, top right). Bottom picture: polycarbonate body on a 22×22 MicCell support.

Different sizes, different materials

Different sizes and layouts are available. Standard dimensions are 22×22, 22×50, and 25×75 (mm×mm). We offer customised chips.

PDMS can be replaced by other materials. The picture above shows a flow cell made from etched silicon anodically bonded to glass. Glass-only chips with polymer channel walls would also fit (the polycarbonate body then has O-ring seals).

Foil-based microfluidics

A great alternative to soft polymers such as PDMS are foil-based microfluidic systems. GeSiM offers customised microfluidic chips with laser-cut adhesive foils in small and large quantities (also as disposables), which snugly fit in the MicCell chamber. This allows intricate multi-layer set-ups so that numerous analytical applications, e.g. point-of-care diagnostics, become feasible, especially with our Fluid Processor (see last page).

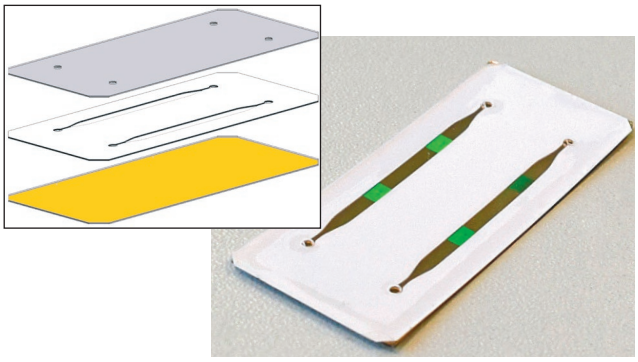
Interesting accessories are highly selective **nanopore membranes** with defined cylindrical holes produced by beaming with heavy ions. This allows e.g. the safe encapsulation of cells, as they cannot penetrate this layer.

Microvalves

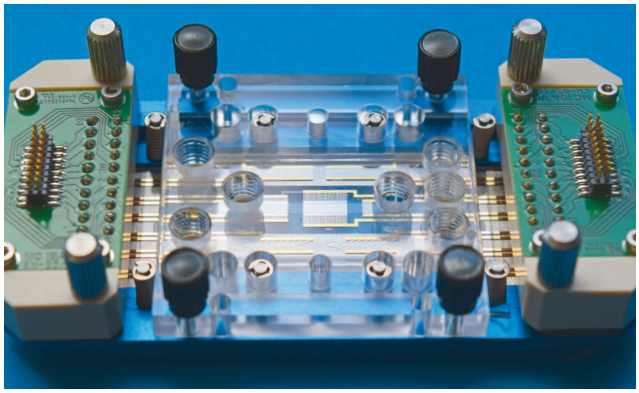
If you need dead-volume-free valves in the microsystem, use our PNIPAM-based hydrogel valves that open upon moderate heating.

Microelectrodes

They are manufactured in our cleanroom; conducting paths to the microelectrodes are insulated by SiO_2 vapour deposition. Designs for heating, temperature sensing, capillary electrophoresis, impedance measurements and more are available; microelectrode arrays can measure or apply electrical potentials while cells are inspected under a microscope. Please ask us if you wish to use your own design.



Biosensor flow cell made of three foils: transparent cover foil with holes, white channel foil, PC foil with four sensor pads (nanoimprinted on a GeSiM µCP4.1 and gold-coated). Used in a MicCell with near-infrared LEDs and wavelength-dependent photodiodes as biosensor for wastewater pollutants..



MicCell with interdigitated electrodes structured on a 25x75 coverslip and connected via spring-loaded contacts (tubes and cables not shown)

2022

FluidProcessor and intuitive control software

All macrofluidic tools (e.g. syringe pumps, multi-port selector valves, 2/2 and 3/2-way valves, mixers, liquid level sensors, air pressure regulators) and controllers of internal devices (microvalves, temperature and flow sensors, voltages/impedances) are mounted in a single box (FluidProcessor) with programmable logic controller (PLC). The FluidProcessor can be modularly equipped with various fluidic and pneumatic tools.

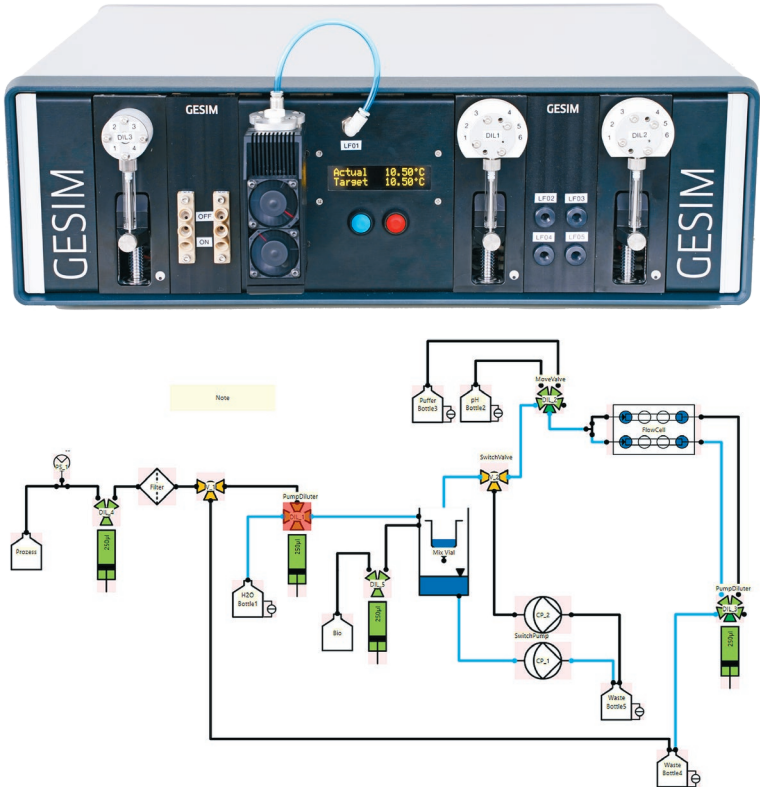
We have developed a clear user interface that automatically detects devices in the FluidProcessor, allowing you to quickly configure (via click & drop) and run any microfluidic setup. You can also compile and run automatic procedures. See separate brochure.

More accessories

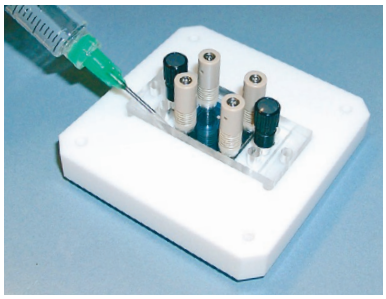
- **Casting station** to mould PDMS channel plates; the PC body (lid) used here also serves as chip-to-world interface
- And: micro-mixers, thin film heaters, thermal sensors, flow sensors (GeSiM specialty), pressure sensors, microelectrode arrays, impedance sensors, 'sample carrier' (to observe opaque objects in the flow)

Literature

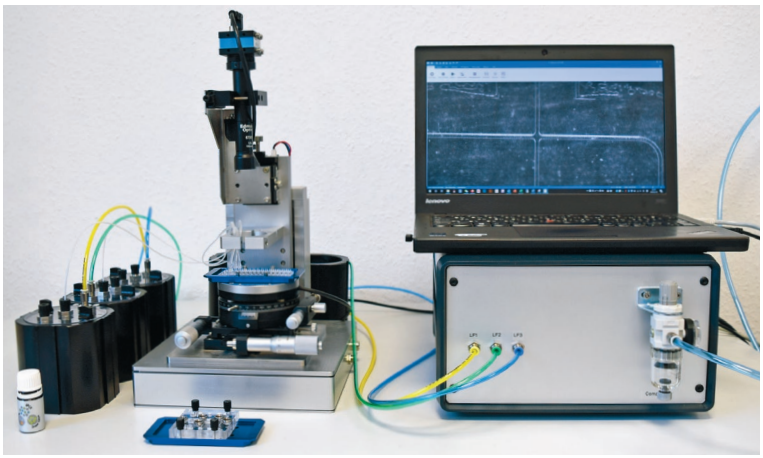
Gast, F.-U. et al., Microfluid. Nanofluid. 2, 2006, 21–36 (DOI: 10.1007/s10404-005-0047-6)



Top, GeSiM FluidProcessor with syringe pumps with selector valves, 3/2-way valves, a pneumatic extrusion module (4…80 °C).and membrane pumps for bulk liquid handling. Bottom, detail of the GeSiM Fluidics software (here for a wastewater biosensor, joint research project 'Anthroplas'). This project won an application award at the 'Analytica Virtual 2020' in the field of water and environmental analytics.



Injection of PDMS into a 22×22 casting station. The silicon master lies at the bottom. Note the brown channel spacers that keep the fluidic connections through the PDMS open.



Microchannel in MIcCell placed in a set-up with video microscope (GeSiM). Here the flow is controlled by air pressure.

Gesellschaft
für Silizium-Mikrosysteme mbH
Bautzner Landstraße 45
01454 Radeberg, Germany
Tel. +49-351-2695 322
Fax +49-351-2695 320
contact@gesim.de
www.gesim.de

For more information or to see the latest product changes and enhancements, please visit our website or call.

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