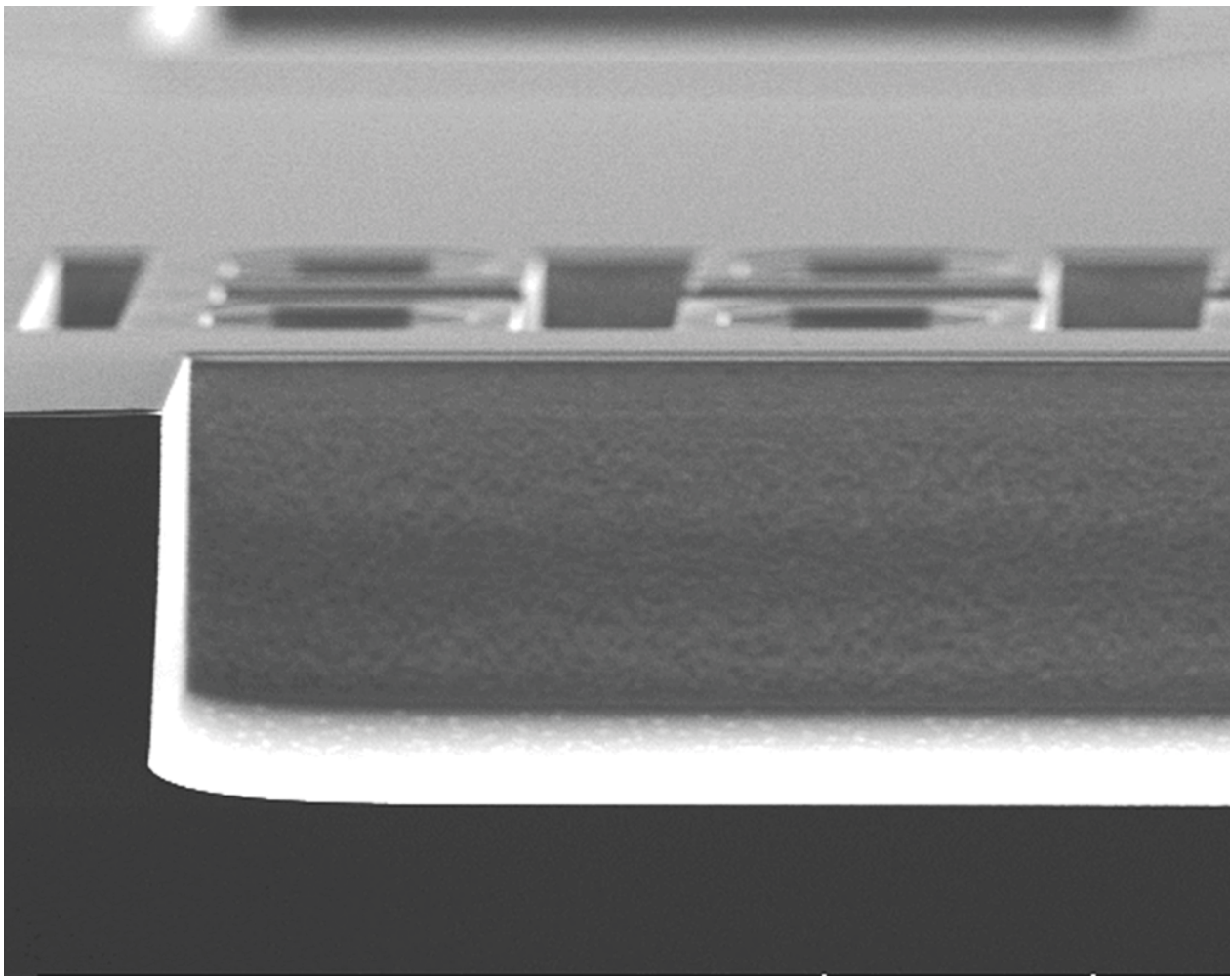
Microfluidics/MST

Built to Order Labs on a Chip



GESIM

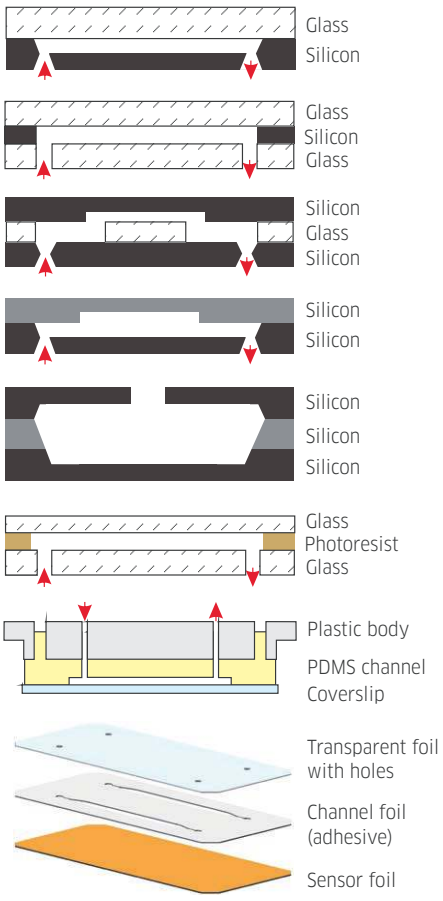
MICROFLUIDICS

Our engineering service for microsystems turns your ideas into products in no time – challenge us!

Miniaturisation is the key to new developments in bioanalytics, chemistry and material science, as it delivers fast results and reduces cost. The buzzwords are MST (microsystems technology) and MEMS (micro-electromechanical, with micro-parts from silicon, glass, and plastic.

You will not find many one-stop shops like ours that provides microfluidic chips, packaging, precision and electronic engineering, plus software development. All in small or large quantities at a competitive price. And we optimize the design until it really works.

Only some of our work is shown here. For more information please visit our homepage.



Microstructuring technologies available at GeSiM. The last two items show the PDMS channel plate of the GeSiM MicCell and an exploded drawing of a multi-layer foil system (example: plasmonic biosensor).

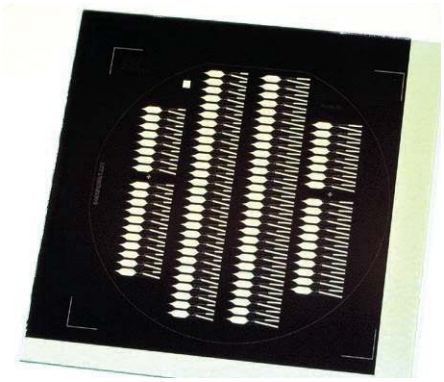
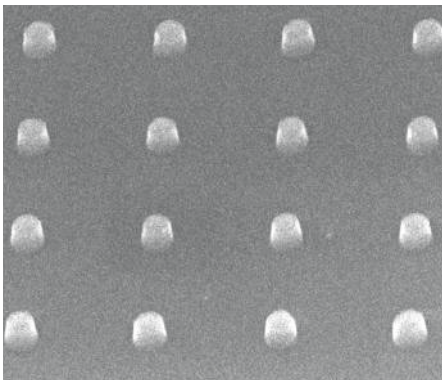


Photo-emulsion mask, 5 inches large



Scanning electron micrograph of a silicon master with nano-pillar array (100 nm diameter)

Photo-emulsion masks

- Glass, 5 inches = 12.5 cm; cost-effective alternative for structures ≥ 25 µm
- Substrate size: 100 mm x 100 mm
- Supported data formats: AutoCAD™ DXF up to release 12 (preferred), Gerber RS-274X, GDS II, CIF (please see homepage)
- Smaller structure sizes can be realized on chrome or electron beam masks (inquire)

Photolithography

- Single- and double-sided on glass, silicon, ceramics; substrates up to 4 inches (10 cm) wide / 150 – 1500 µm thick
- Dry and wet photoresists, 0.3 – 150 µm thick
- Photo-epoxy SU-8, 10 – 25 µm thick

3D structuring

- Anisotropic wet-chemical etching of Si with KOH: inexpensive batch process, smooth surface, side wall angle depends on crystal orientation –> (100) vs. (110) wafers
- Anisotropic plasma-enhanced dry Si etching (ASE/Bosch process): single wafers, dense structures, vertical side walls
- Super-rough surfaces by etching in SF_6/C_4F_8 plasma
- Isotropic wet etching of glass with HF: round channels, 3 – 700 µm deep

Technology	Channel Height [µm]
Silicon–glass	10 – 800
Glass–silicon–glass	10 – 1000
Silicon–glass–silicon	150 – 1000
Silicon–silicon–silicon	10 – 500
Glass–polymer–glass	15 – 120
PDMS channel plate	1 – 300
Multi-layer chips from adhesive transparent/non-transparent foils	10 – 500

- Ultrasonic drilling and micro-blasting for 150 – 1000 µm thick glass, Si, quartz (please inquire)

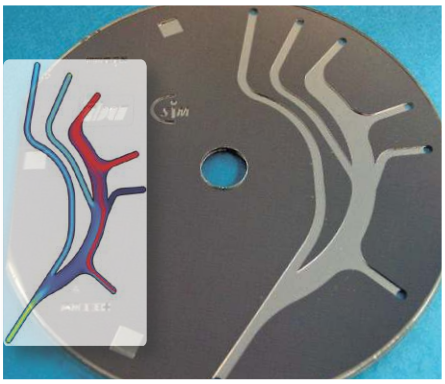
Master tools for polymer embossing and microcontact printing

We have optimised the manufacturing of masters for PDMS moulding and hot embossing (of e.g. PMMA or TOPAS) by anisotropic Si etching in SF_6/O_2 plasma:

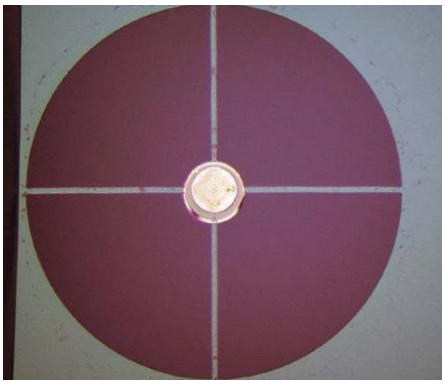
- Surface is always Teflon-coated for easy demoulding
- Nano-masters: require electron beam lithography (please inquire)
- Microcontact printing (µCP): masters for stamps, also casting stations and even fully automatic printers are available (see separate brochure)

Specialties (selection)

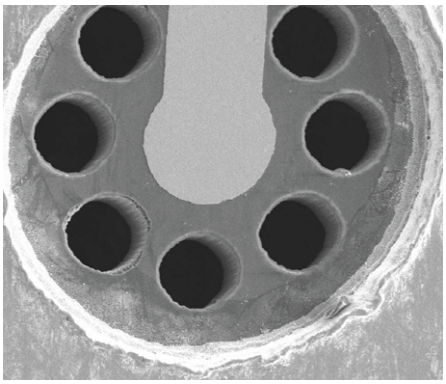
- Thin film heaters and temperature sensors, insulated by vapour deposition of SiO_2
- Microelectrode arrays (MEAs), e.g. for impedance measurements
- PDMS channels: MicCell (see extra brochure)
- Foil-based microfluidics with complex multi-layer structures, also disposable (in GeSiM “MicCell” or standalone)
- Integration of “track-etched” nanopore membranes from Oxyphen, Switzerland
- Microvalves: hydrogel microvalves (containing PNIPAAm particles), rotary valves with PDMS seal (please inquire)
- Special pre-structured targets (e.g. hydrophobic/hydrophilic and anti-fouling coatings, MALDI targets from silicon)
- Control electronics
- PLC-based control software (GUI)



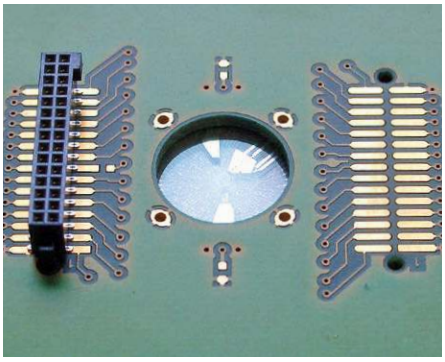
Silicon-glass channel system for magnetic separation of blood immune cells (inset: flow simulation). Project funded by BMBF, Germany.



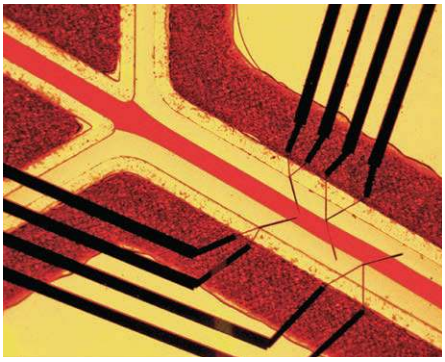
Cr-Au metal foil (diam. 75 µm) for laser detector, freely suspended in Si chip with Si_3N_4 beams



Microgalvanically deposited Ag layer (70 µm high) and through-etched holes in a Clark electrode



Microelectrode array on glass chip, for impedance and activity measurements with nerve or muscle cells



Dielectrophoretic cell handling glass chip with double-layer Pt electrodes, SU-8 walls; the central red stream is focussed by sheath flows (EU project CellPROM).

Foil-based microfluidics: microscopic image of an Oxyphen membrane with defined pores (speckles) on an adhesive foil with round hole and channel

Physical vapour deposition (PVD) by magnetron sputtering and electron beam deposition

- Resolution: 2 µm
- Conductors (Al, Ti. Au, Pt, Ta): 20 – 200 nm thick, patterning by lift-off and etching technologies; resistance in the µΩ range
- Transparent conductors: ITO-90/10 (90% In_2O_3 / 10% SnO_2) or TiO_2; patterning as above, resistance 30 – 50 µΩ
- Evaporated quartz (Si_xO_y): coating at 150 °C; e.g. to insulate conductor paths

Plasma-enhanced chemical vapour deposition (PECVD)

- Insulators: silicon dioxide (SiO_2), silicon nitride (Si_3N_4), oxynitride ($Si_xO_yN_z$); 20 nm to 1.5 µm thick, patterning by reactive ion etching (RIE) and wet-chemical etching
- Fluorocarbon (C_xF_y) layers, similar to Teflon: 50 nm to 2 µm thick, patterning by RIE in O_2 plasma

Microgalvanics

Galvanic deposition of thick layers of Ni (70 µm), Ag (70 µm), Au (10 µm), after lift-off microstructuring

Bonding

The firm connection of two different layers; for up to 4 inch (10 cm) wafers. The glass-silicon-glass bonding is a GeSiM patent.

- Anodic bonding: irreversible, 5 µm accuracy, by high voltage at 300 – 450 °C; double/triple sandwiches of silicon and Pyrex glass, also insulator (Si_3N_4) on Si
- Silicon fusion (direct) bonding: adhesive at 950 – 1100 °C under N_2 after acidic pretreatment, for Si double layers
- Die bonding with adhesives: 5 µm accuracy, CAD and production of sieves (for adhesive bonding) or polymer spacers, also conductive adhesives, on wafers and chips
- Wire bonding: material AlSi1; on or between glass, Si, ceramics or PCBs with metal bond pads; min. bond pad area 30x30 µm, sealing of bond wires with epoxy

Wafer dicing

- For up to 6" (15 cm) wafers, or on request
- Thickness: Si ≤ 2 mm, glass ≤ 1.5 mm, ceramics ≤ 1.5 mm, stainless steel ≤ 1 mm
- Support: pressure-sensitive or UV curing tape, dicing wax

Foil-based microfluidic systems

- Multi-layer chips from adhesive foils
- Completely customized (please inquire)
- Different polymer materials, different manufacturing technology (mechanical cutting or laser, dependent on resolution)
- Option: (nano-)pore membranes

Screen printing

- Printing of SMD adhesives or silicone rubber on PCBs and microsystem substrates
- Including sieve design and production
- Typical thickness: 15 – 35 µm

Packaging, liquid handling, instrument design

CAD is used to fit the microsystem to the macro-world.

- Hybrid integration of Si or glass chips in ceramic or other wire bonding mounts
- Innovative electrical, fluidic and mechanical joining technology
- Mechanical carriers and housings
- Integration of macrofluidic components (e. g. valves, pumps) or custom-specific parts; see also MicCell brochure
- Development of hard- and software to build customized parts or instruments

2019

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Specifications subject to change without notice

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