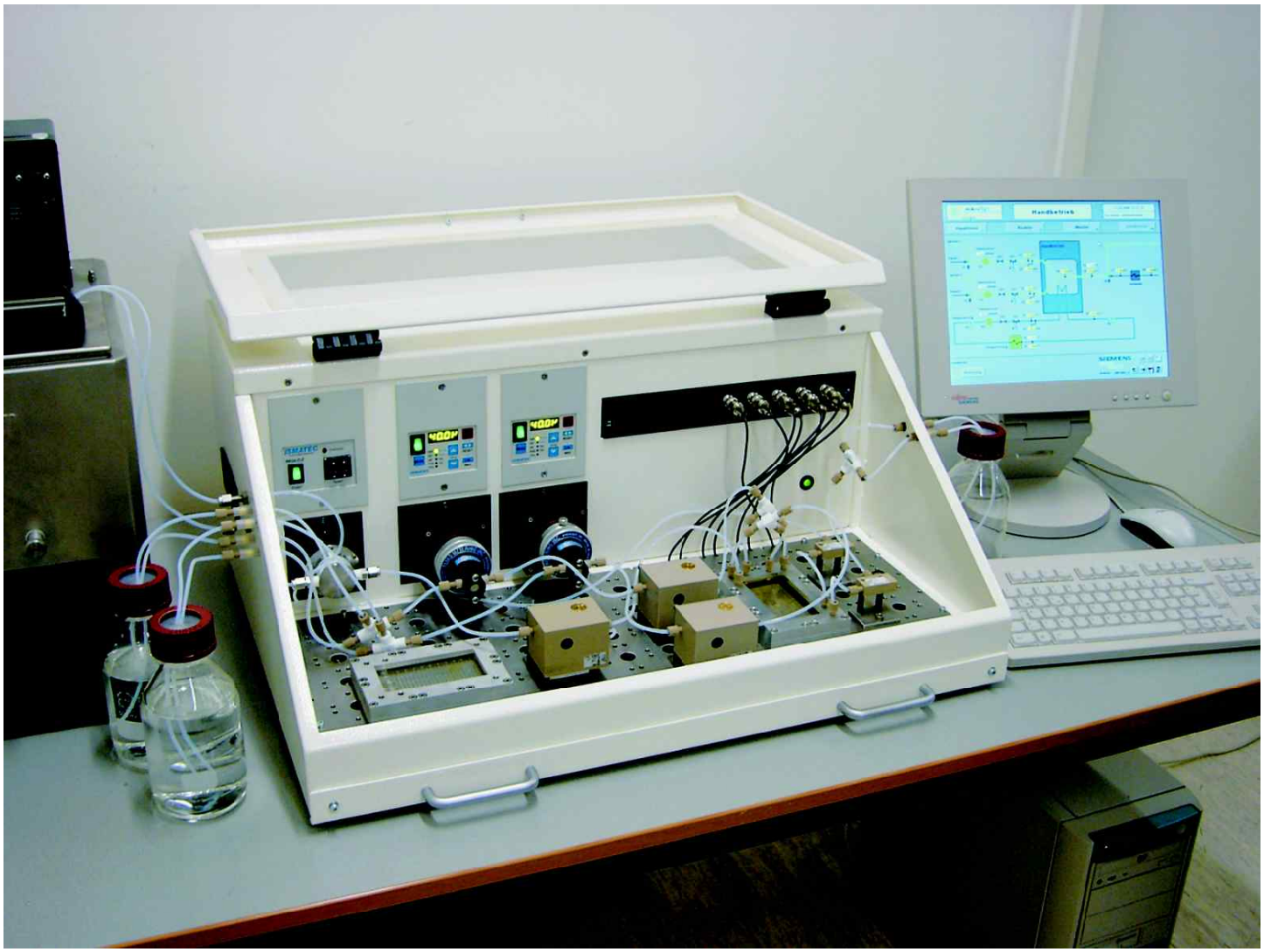
Microreaction Technology



Chemical Process Technology of Tomorrow

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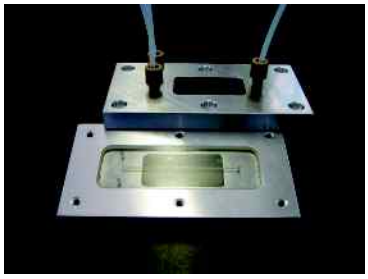
mikroglas

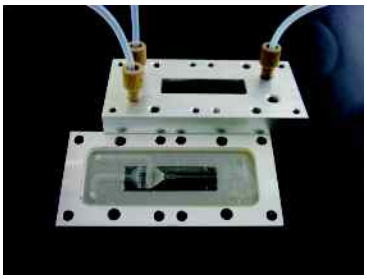
Overview Microreaction Products

mikroglas chemtech GmbH develops and manufactures microreaction products made of glass, for example, microreaction modules such as static mixers, heat exchangers or a combination of both. The material glass makes the reactor modules resistant against aggressive media.



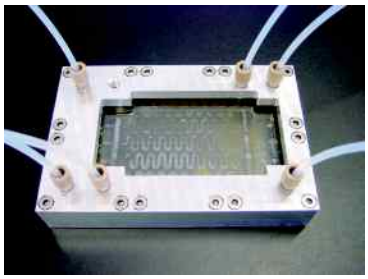
T-Mixer (page 2)

This mixer can be used to form a regular plug flow for two-phase organic systems. Different channel geometries are available. Therefore the mixer can be used for a wide variety of processes.



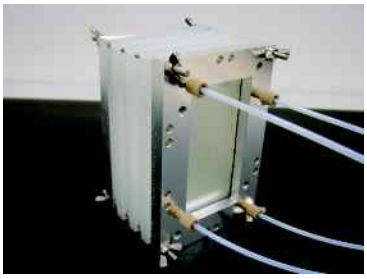
Interdigital Micro Mixer (page 3-6)

This mixer combines the regular flow pattern created by multi-lamination with geometric focussing. This speeds up liquid mixing of the multilamellae. The mixer can be used for a wide variety of processes such as mixing, emulsification, single-phase organic synthesis, and multi-phase organic synthesis.



Interdigital Mixer with Heat Exchanger (page 7-9)

This device comprises a stack of several micro structured plates that are arranged to build a mixer and heat exchanger. The mixer plate consists of 5 parallel reaction channels of 500µm width and 200µm depth. The device is utilized for liquid/liquid and gas/liquid phase reactions.



Counter Flow Micro Heat Exchanger (page 10)

This device comprises a stack of several micro structured plates that are arranged for a counter- or co-current flow practice. Each plate consists of 20 parallel micro channels of 1.4 mm width and 0.5 mm depth. The plate stack is encompassed by PTFE plates, for thermal insulation against the environment and the two steel caps. The device is utilized for liquid-phase micro heat exchanging.

Falling Film Micro Reactor (page 11)

This reactor utilizes a multitude of thin falling films that move by gravity force exhibting typical residence times of seconds up to about one minute. It's unique properties are the specific interface of 20,000 m^2/m^3 and the excellent temperature control trough the integrated heat exchanger. The reaction plate is available with different channel dimensions.

*mikro*Syn microreaction System (page 12-16)

The ***mikro***Syn microreaction laboratory system is designed to run a micro reactor under controlled conditions. It is utilizing innovative microreactor components in combination with well-proven standard fluidic equipment. The system consists of 2 rotary pumps, 1 gear pump, valves, pressure and temperature sensors. The heating/cooling circulation is temperature controled by a Huber polystat. The microreaction system is controlled by a SIMATIC S7-300 Control System by Siemens.

mikroglas sensors (page 17)

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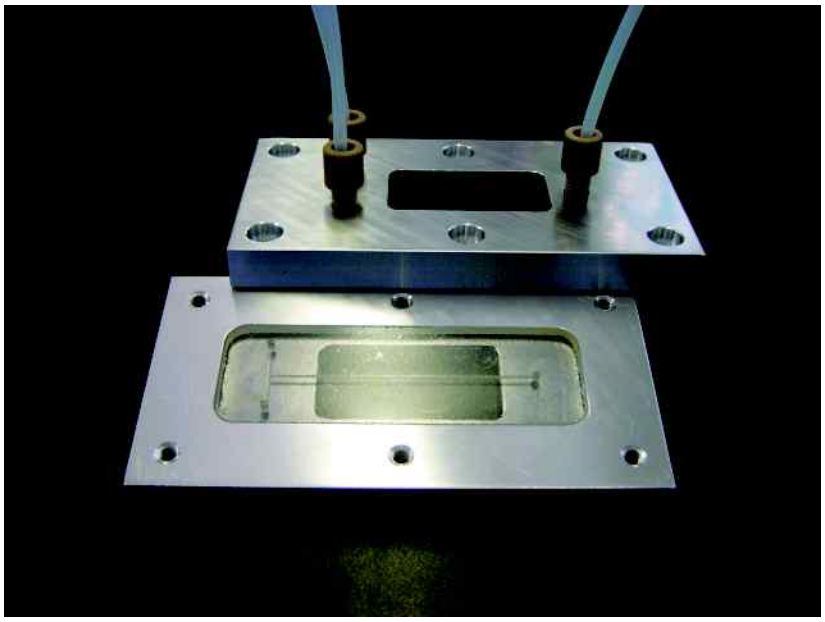
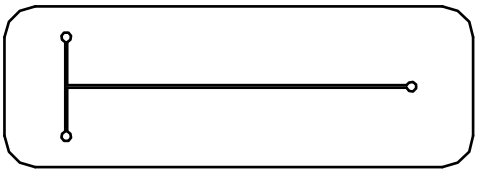
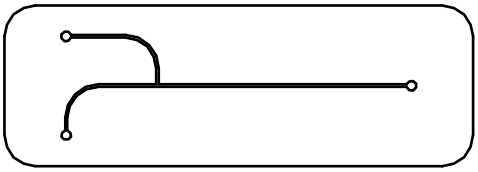
mikroglas mixer
T-mixer design

mikroglas chemtech GmbH develops and manufactures microtechnological products made of glass (FOTURAN), as for example microreactor modules, such as static mixers, heat exchangers, or a combination of both. The material glass makes the reactor modules resistant against aggressive liquids. Due to its optical transparency it is also possible to use the system for photochemical applications.

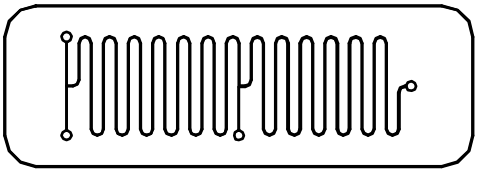




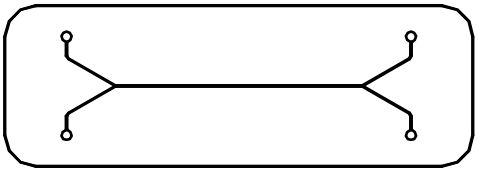
T-mixer design MMH 010



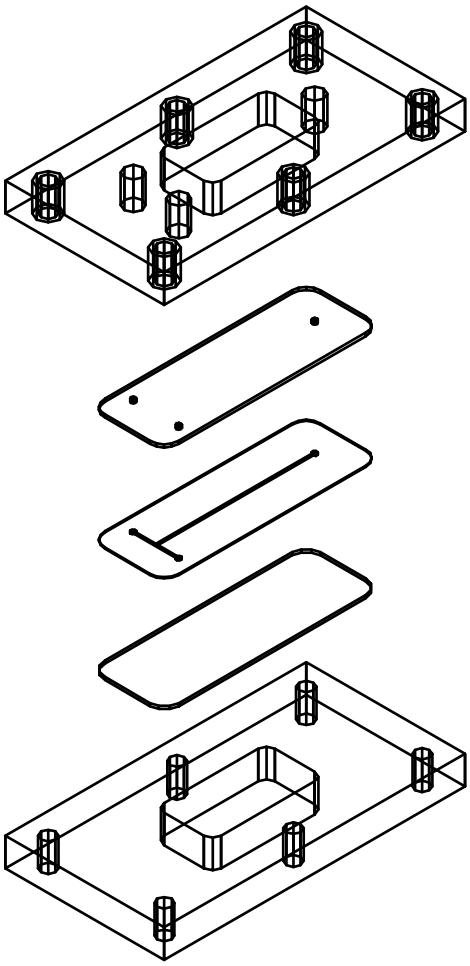
J-mixer design MMH 012



two step T-mixer design MMH 014



2 inlet / 2 outlet Y-mixer design MMH 016



specifications	
number of layers	3
layer thickness	0.4 mm - 1 mm
outer dimensions	106 mm x 56 mm x 25 mm
number of reaction channels	1
channel dimensions	height: 0.15 mm - 0.4 mm
	width: 0.05 mm - 0.4 mm
reaction channel	length: 40 mm - 450 mm
flow rate	up to 5 l/h
maximum viscosity	appr. 22.5 mPas
connection	by ready-made Teflon tubes (UNF thread 1/4“)

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mikroglas mixer interdigital

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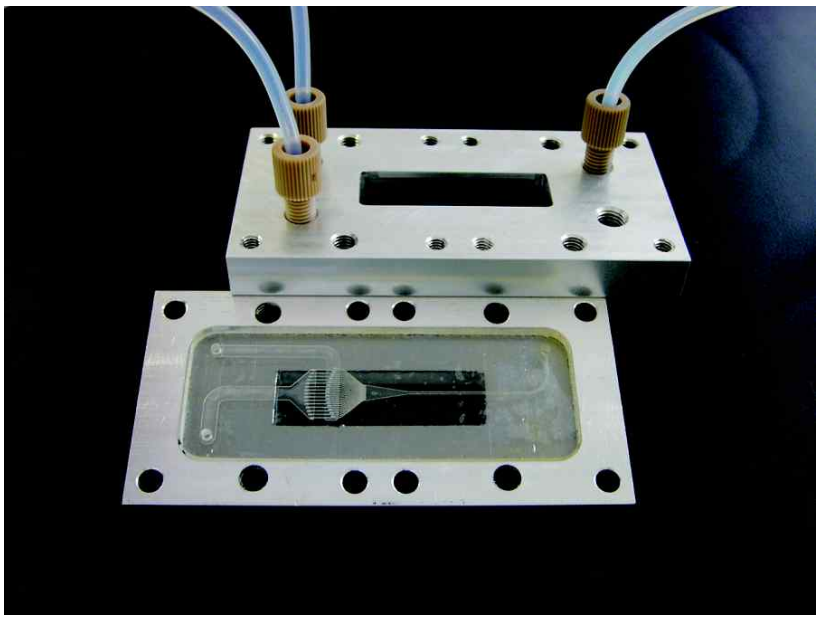
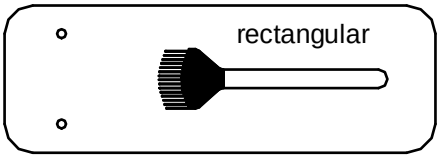
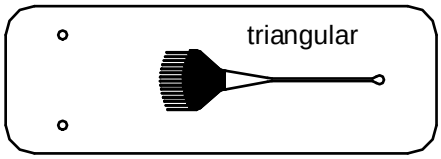
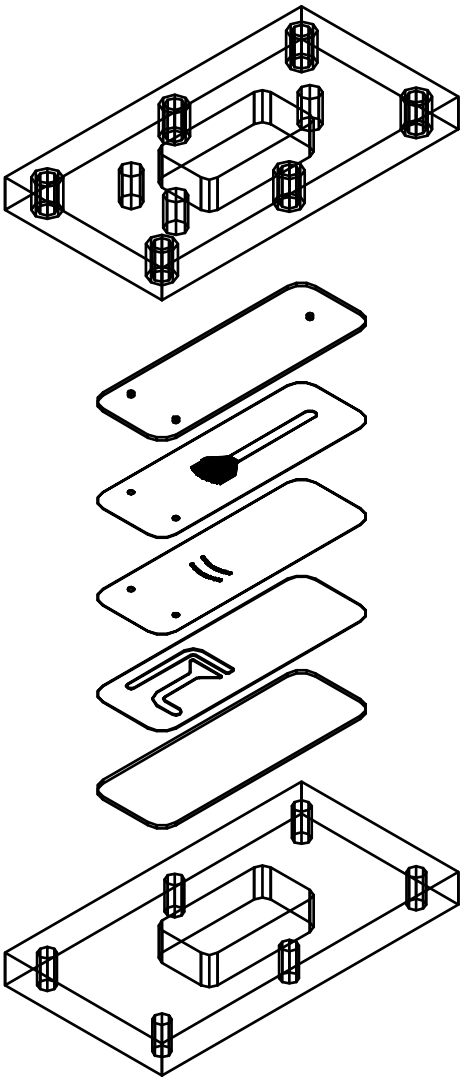


The mixer is available with two different designs of the mixing chamber:

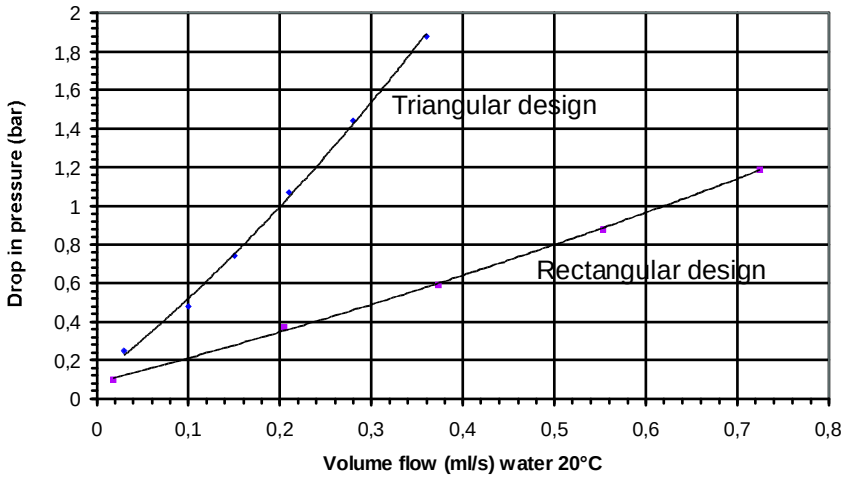




Developed in co-operation with the Institut für Mikrotechnik Mainz GmbH



specifications	
number of layers	5
layer thickness	150 µm - 1 mm
outer dimensions	106 mm x 56 mm x 25 mm
number of reaction channels	30
channel dimensions (inlet)	height: 150 µm
	width: 50 µm
reaction channel	length: 25 mm
flow rate	up to 2000 ml/h
connection	by ready-made Teflon tubes (UNF thread 1/4“)



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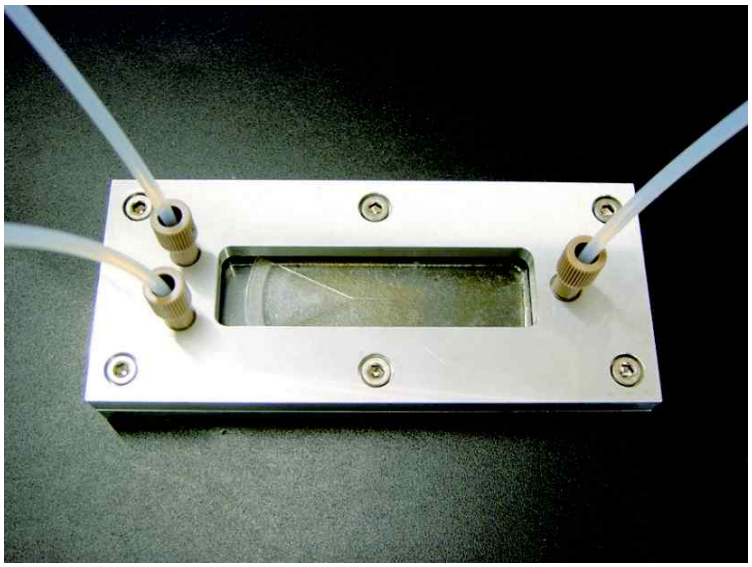
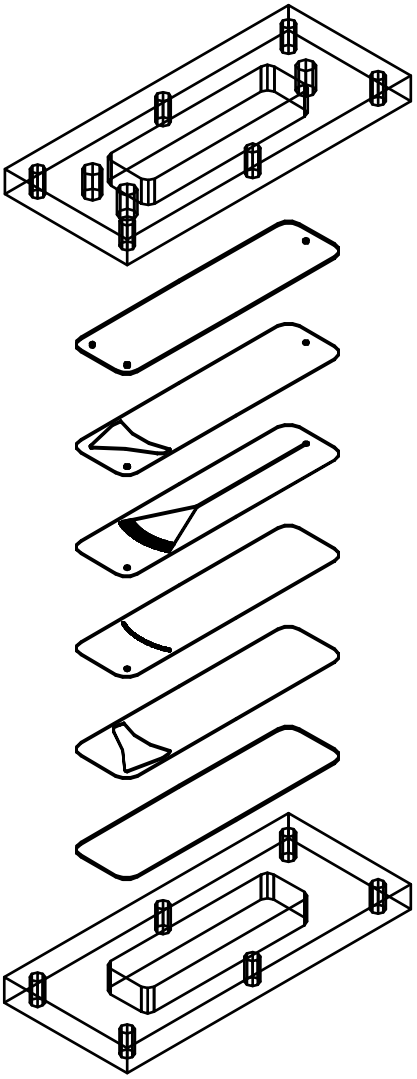
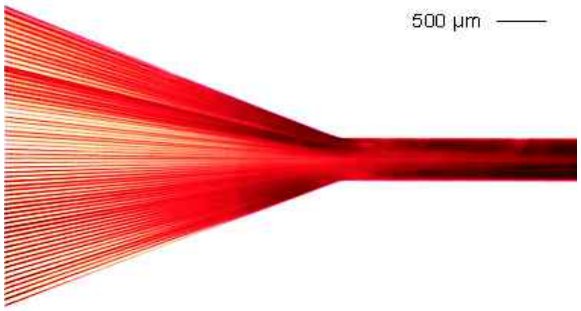
mikroglas mixer
SuperFocus design

mikroglas

mikroglas chemtech GmbH develops and manufactures microtechnological products made of glass (FOTURAN), as for example microreactor modules, such as static mixers, heat exchangers, or a combination of both. Due to the strong focusing within the mixing chamber a very fast mixture can be obtained even for high flow rates. The material glass makes the reactor modules resistant against aggressive liquids. Due to its optical transparency it is also possible to use the system for optical analysis.







Iron rhodanide reaction (Volume flow 5 l/h)

specifications	
number of layers	6
layer thickness	0.5 mm - 1 mm
outer dimensions	130 mm x 56 mm x 25 mm
number of feeding channels	124
channel dimensions (inlet)	height: 0.5 mm
	width: 100 µm
reaction channel	length: 50 mm
flow rate	up to 10 l/h
connection	by ready-made Teflon tubes (UNF thread 1/4“)

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mikroglas mixer cyclone design

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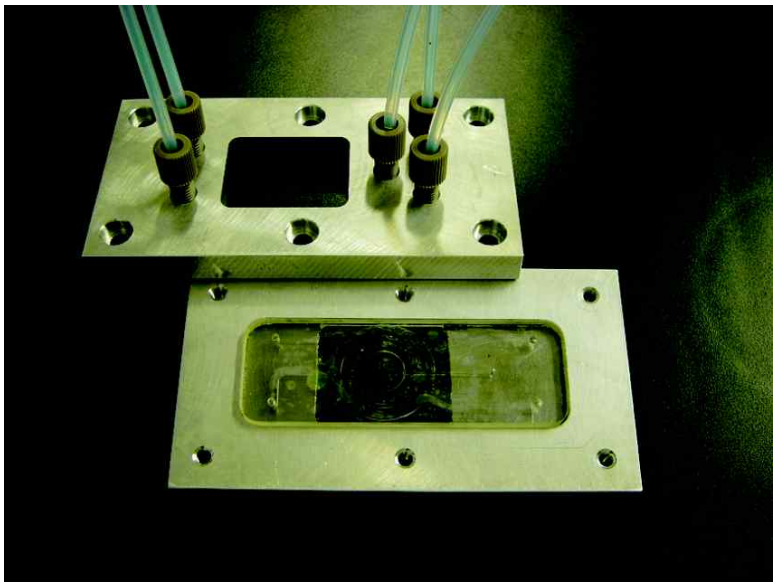

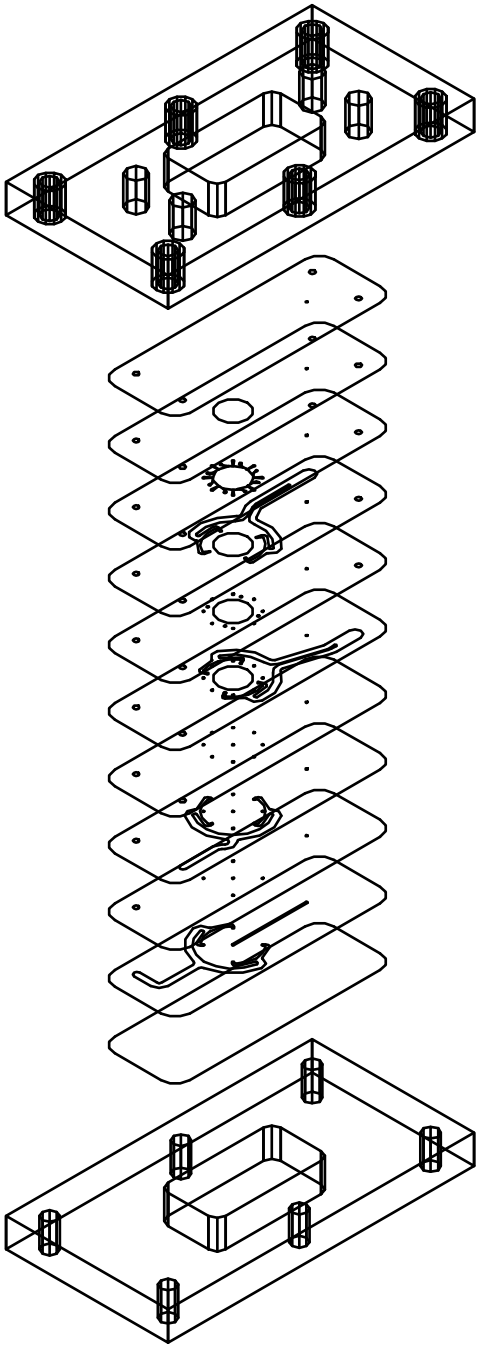

specifications	
number of layers	11
layer thickness	150 µm - 0.5 mm
outer dimensions	106 mm x 56 mm x 25 mm
mixing chamber	diameter: 10 mm
	height: 2.15 mm
channel dimensions (inlet)	height: 150 µm
	width: 50 µm
connection	by ready-made Teflon tubes (UNF thread 1/4“)

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mikroglas mixer pillar design

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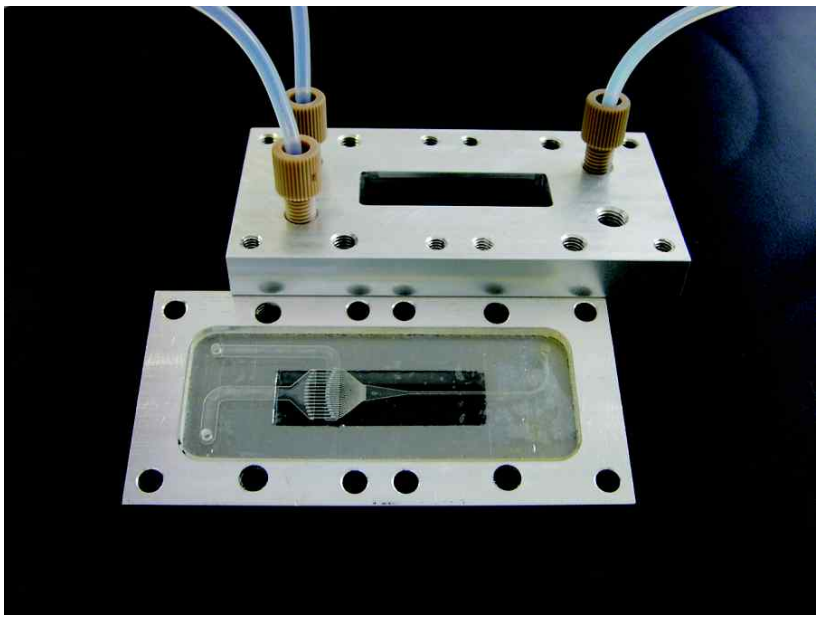
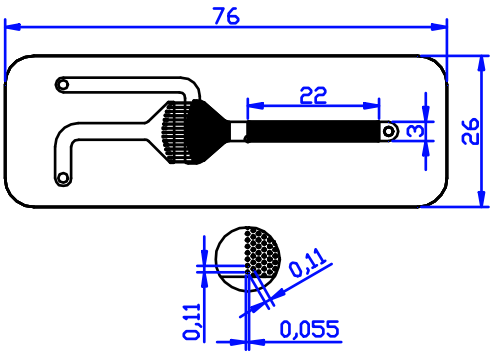
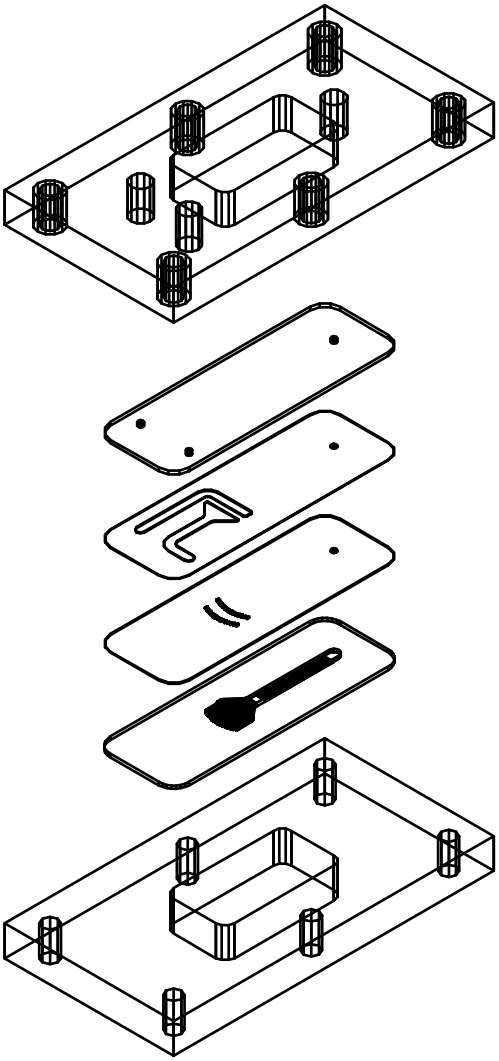
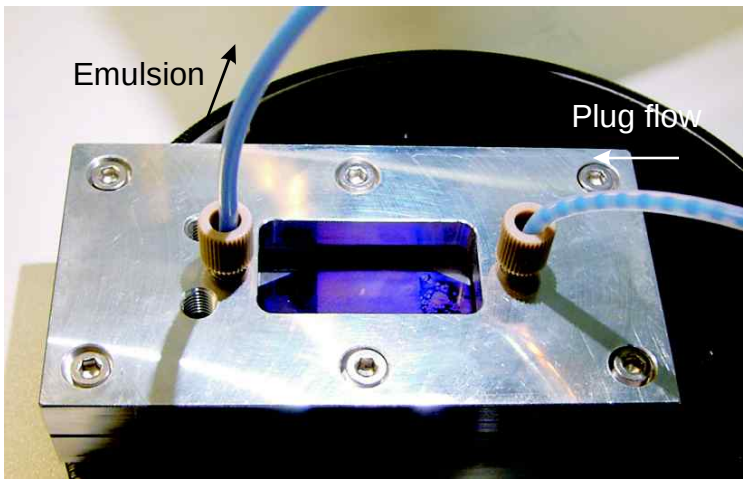




The reaction channel contains a field with 15,000 pillars. When a plug flow is running through this field the plugs will break up resulting in a homogeneous emulsion.



specifications	
number of layers	4
layer thickness	150 µm - 1 mm
outer dimensions	106 mm x 56 mm x 25 mm
number of reaction channels	30
channel dimensions (inlet)	height: 150 µm
	width: 50 µm
reaction channel	length: 25 mm
flow rate	up to 500 ml/h
connection	by ready-made Teflon tubes (UNF thread 1/4“)



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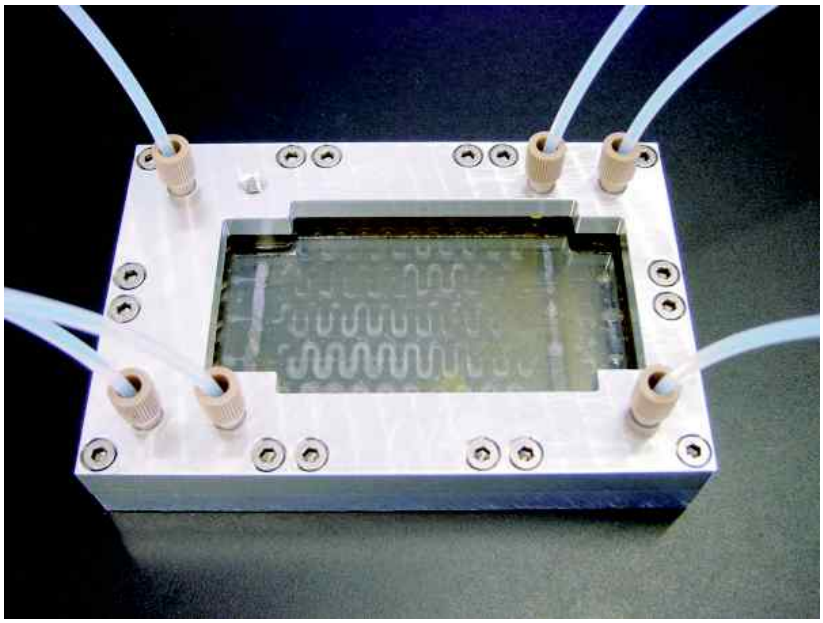
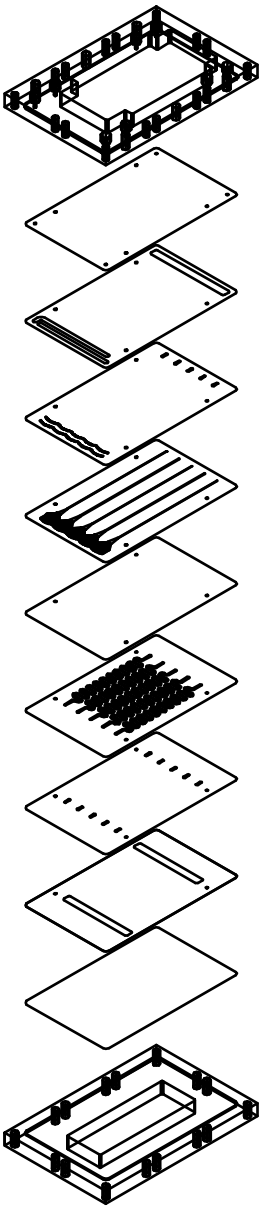
mikroglas reactor interdigital triangular design

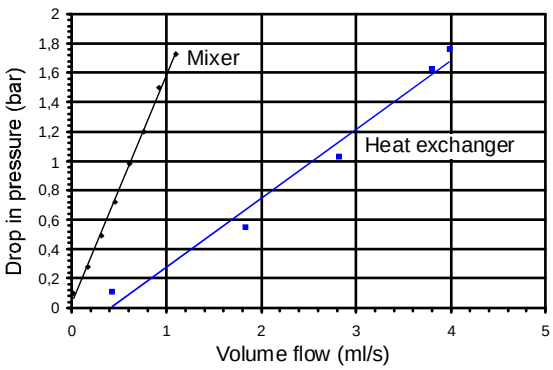
mikroglas

The range of products for microreaction technology produced by the ***mikroglas chemtech GmbH*** includes ready-to-connect modules such as different static mixers, microreactors, heat-exchangers and dwell devices, The new ***mikroglas*** reactor has new designed interdigital mixing structures and therefore an essentially higher efficiency. The material glass makes the reactor modules resistant against aggressive liquids. Due to its optical transparency it is also possible to use the system for photochemical applications.





Specifications	
Number of layers	9
layer thickness	0.2 mm to 2 mm
outer dimensions frame	135 mm x 90 mm x 25 mm
outer dimensions glass part	118 mm x 73 mm x 7.5
number of reaction channels	5
reaction channel dimensions	height: 0.25 mm
	width: 0.5 mm
	length: 100 mm
heat exchange area	250 mm²
flow rate product	appr. 2 l/h (water 20°C; 1bar)
flow rate heat exchange fluid	appr. 10 l/h (water 20°C; 1bar)
connection	by ready-made Teflon tubes (1/4“ UNF threat)



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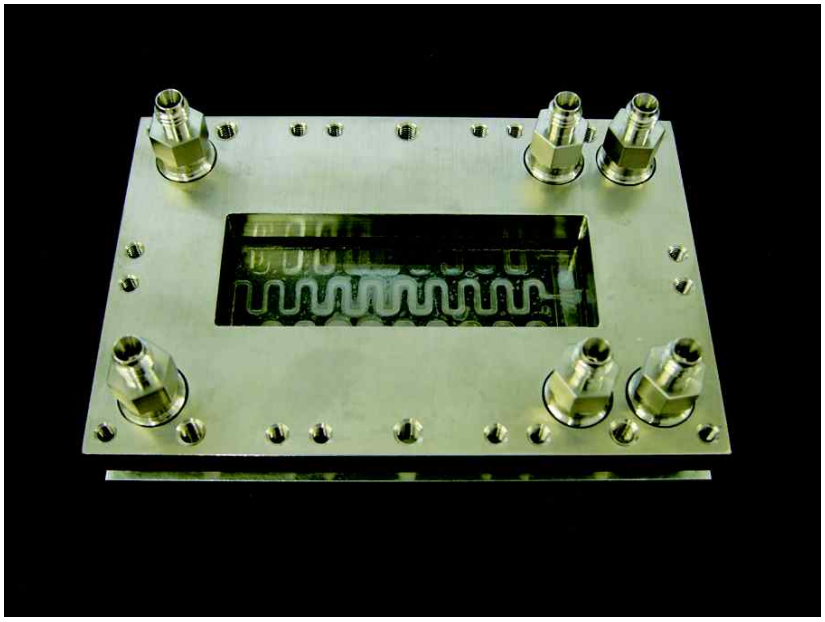
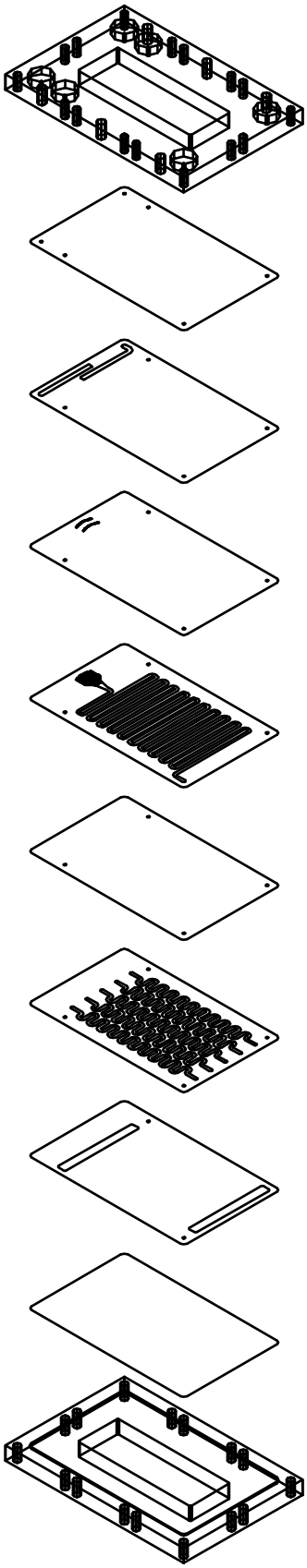
mikroglas reactor interdigital triangular design single channel -8-

The range of products for microreaction technology produced by the ***mikroglas chemtech GmbH*** includes ready-to-connect modules such as different static mixers, microreactors, heat-exchangers and dwell devices, The new ***mikroglas*** single channel reactor has an interdigital mixing structure followed by a 1.10 m long reaction channel. Depending on the flow rate the user can achieve a residence time in the range of minutes. The material glass makes the reactor modules resistant against aggressive liquids.



mikroglas single channel reactor with Swagelok connections.
A version with HPLC fittings and Teflon tubes is also available.



Specifications

Number of layers	8
layer thickness	0.2 mm to 1.0 mm
outer dimensions frame	135 mm x 90 mm x 25 mm
outer dimensions glass part	118 mm x 73 mm x 7 mm
number of reaction channels	1
reaction channel dimensions	height: 0.5 mm
	width: 2.0 mm
	length: 1.10 m
heat exchange area	1100 mm²
flow rate product	appr. 2.6 l/h
related drop in pressure	appr. 2.0 bar (water at 20 °C)
flow rate heat exchange fluid	appr. 12 l/h
related drop in pressure	appr. 1.6 bar (water at 20 °C)
connection	Swagelok connections or ready-made Teflon tubes (1/4“ UNF threat)

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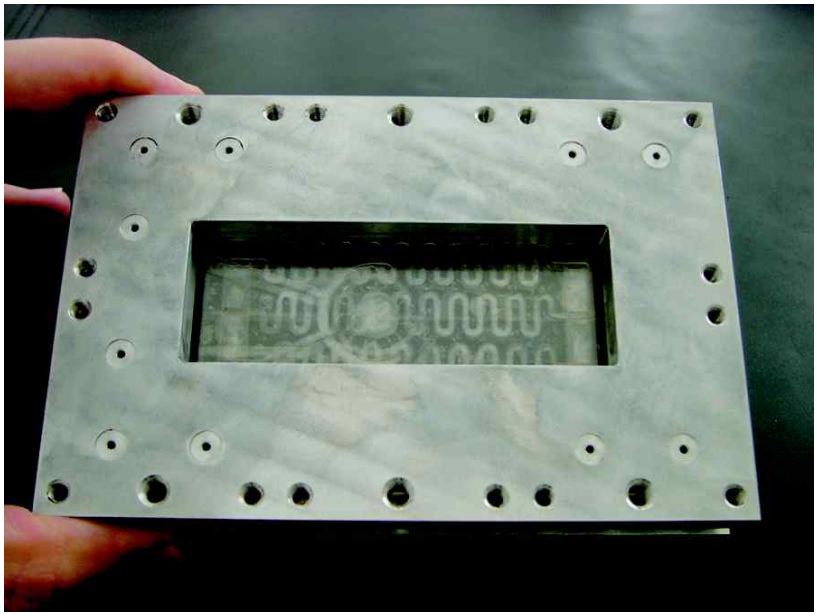
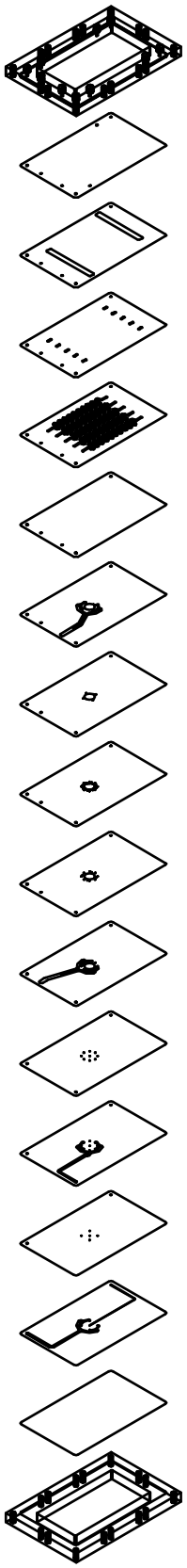
mikroglas reactor cyclone design

mikroglas

The range of products for microreaction technology produced by the ***mikroglas chemtech GmbH*** includes ready-to-connect modules such as different static mixers, microreactors, heat-exchangers and dwell devices.
The ***mikroglas*** reactor cyclone design has a new designed mixing structure for gas liquid mixing. The material glass makes the reactor modules resistant against aggressive liquids. Due to its optical transparency it is also possible to use the system for photochemical applications.





Specifications	
Number of layers	15
layer thickness	0.2 mm to 2.0 mm
outer dimensions frame	135 mm x 90 mm x 25 mm
outer dimensions glass part	118 mm x 73 mm x 7.5
inlet nozzles	8 liquid, 8 gas
width nozzles liquid	0.070 mm
width nozzles gas	0.050 mm
mixing chamber dimensions	height: 2.5 mm diameter: 10 mm
flow rate liquid	up to 1.0 l/h
flow rate gas	up to 12 l/h
flow rate heat exchange fluid	appr. 10 l/h (water 20°C; 1bar)
connection	by ready-made Teflon tubes (1/4“ UNF threat)

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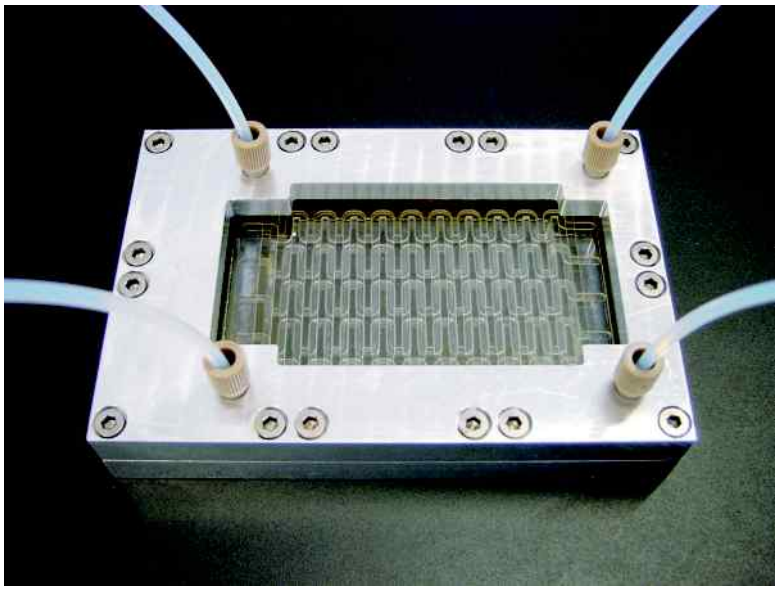
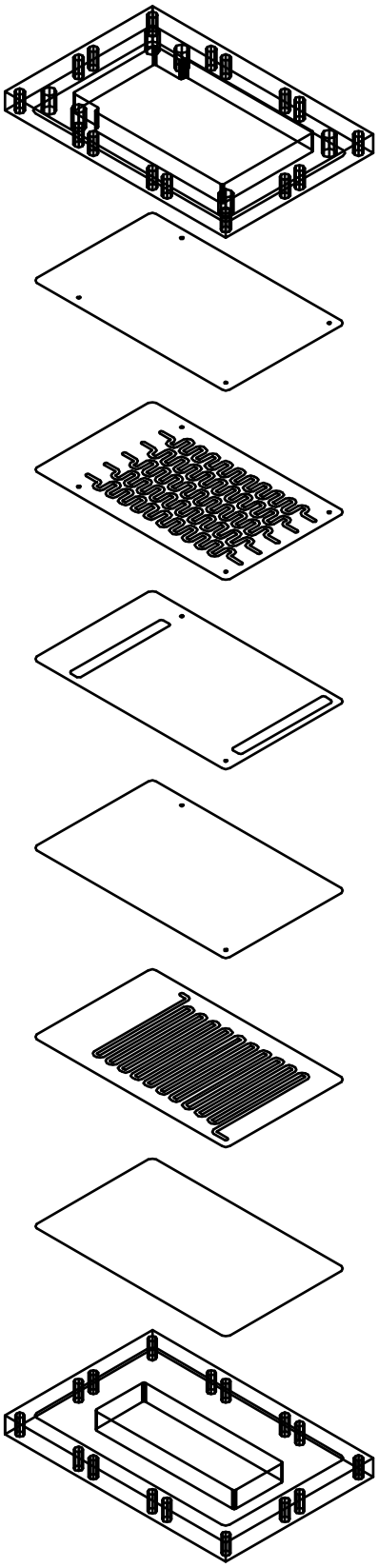
mikroglas dwell device

mikroglas

The range of products for microreaction technology produced by the ***mikroglas chemtech GmbH*** includes ready-to-connect modules such as different static mixers, microreactors, heat-exchangers and dwell devices,
The ***mikroglas*** dwell device has a 1.15 m long channel which offers extended reaction time under controled temperature conditions. The material glass makes the fluidic modules resistant against aggressive liquids. Due to its optical transparency it is also possible to use the system for photochemical applications.





Specifications	
Number of layers	6
layer thickness	0.2 mm to 2 mm
outer dimensions frame	135 mm x 90 mm x 25 mm
outer dimensions glass part	118 mm x 73 mm x 7.5
number of reaction channels	1
reaction channel dimensions	height: 0.5 mm
	width: 2.0 mm
	length: 1.15 m
heat exchange area	2300 mm²
flow rate product	appr. 2 l/h (water 20°C; 1bar)
flow rate heat exchange fluid	appr. 10 l/h (water 20°C; 1bar)
connection	by ready-made Teflon tubes (1/4“ UNF threat)

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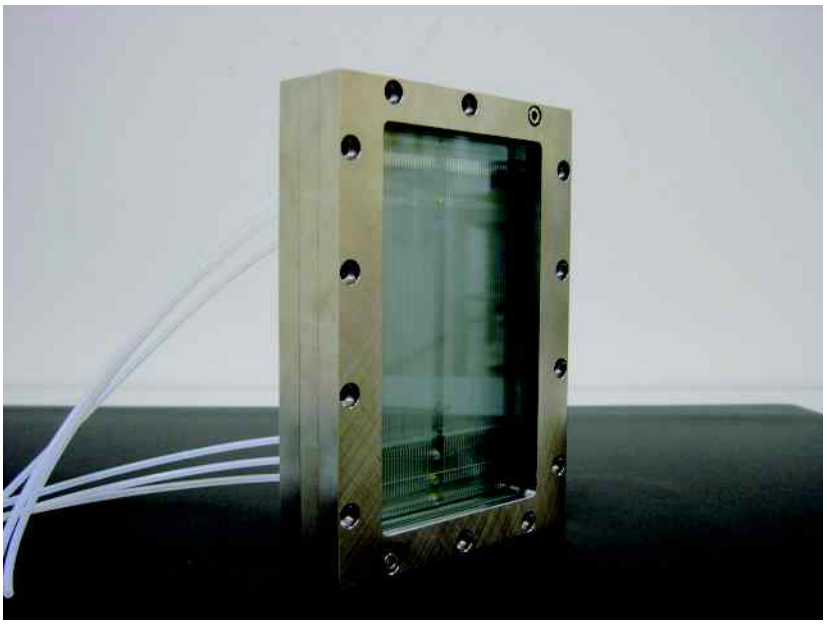
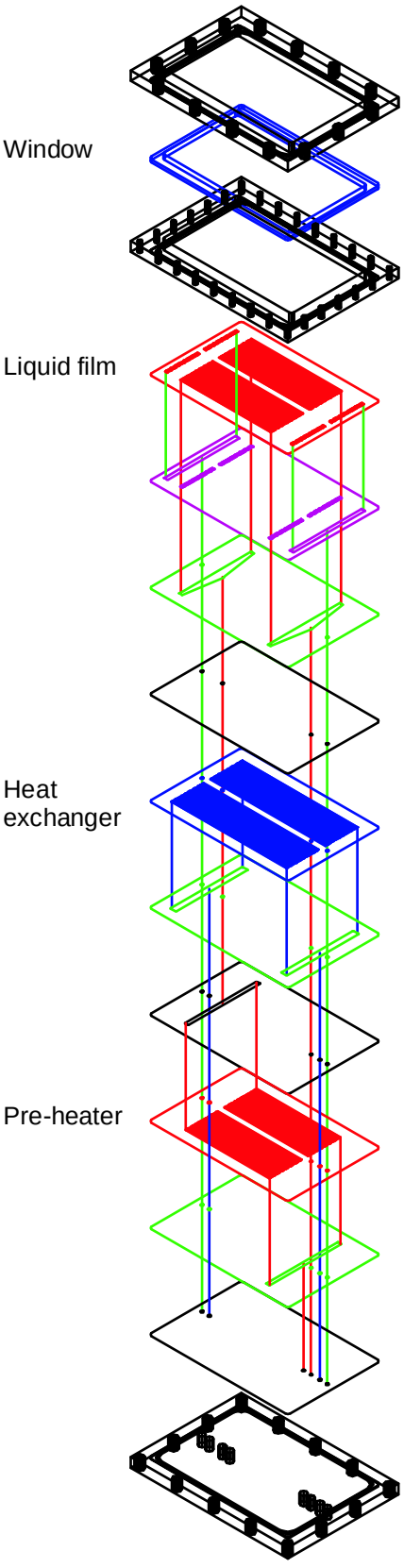
mikroglas reactor falling film design

The range of products for microreaction technology produced by the ***mikroglas chemtech GmbH*** includes ready-to-connect modules such as different static mixers, microreactors, heat-exchangers and dwell devices.
The ***mikroglas*** reactor falling film design was developed to carry out gas liquid reactions under controlled conditions. The glass module contains therefore a heat exchanger for preheating the liquid and to control the reaction temperature. The gas and liquid feed was designed to perform optimal flow distribution.
The material glass makes the reactor modules resistant against aggressive media. Due to the optical transparency of the window it is also possible to use the system for photochemical applications.





Specifications	
Number of layers	10
layer thickness	0.2 mm to 2.0 mm
outer dimensions frame	170 mm x 120 mm x 30 mm
outer dimensions glass part	150 mm x 100 mm x 8.0 mm
height of gas chamber	0.5 mm up to 5.0 mm
falling film channels	width/depth: 0.5 mm
	length: 98 mm
area (48 channels in parallel)	2350 mm²
flow rate liquid	up to 5.0 ml/min.
flow rate gas	up to 100 ml/min.
flow rate heat exchange fluid	appr. 10 l/h (water 20°C; 1bar)
connection	by ready-made Teflon tubes (1/4“ UNF threat)

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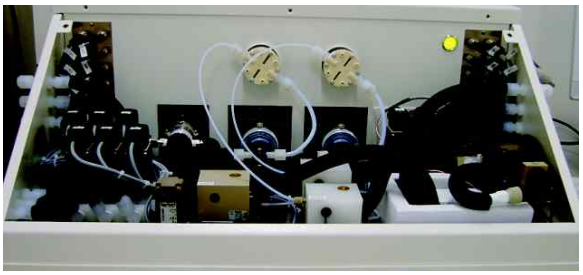
The system consists of 2 rotary pumps, 1 gear pump, valves, pressure and temperature sensors. The heating/cooling circulation is tempered by a Huber polystat. The microreaction system is controlled by a SIMATIC S7-300 Control System by Siemens.

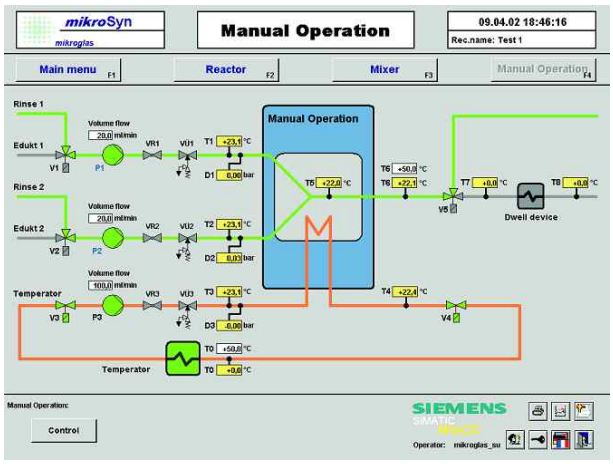
Box:

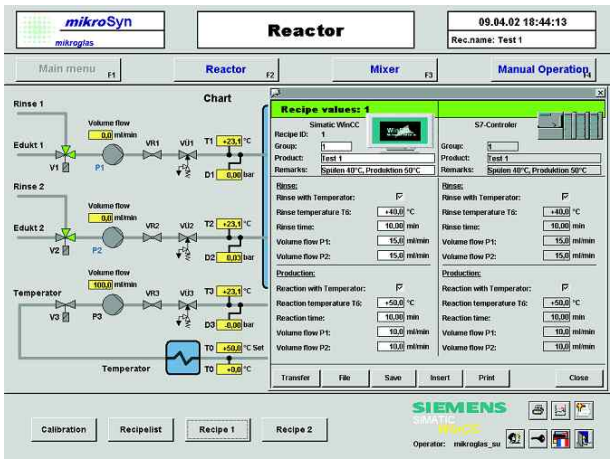
outer dim.: 700 mm x 680 mm x 310 mm
weight: approx. 30 kg

Control System:

The control system enables the user to adjust all parameters by a user interface. When running in manual mode all settings can be made by free choice. It is also possible to store the parameters in a file. This can be loaded, edited and executed to generate different programs. All measured data are available online and can also be printed or exported to a file.







Microfluidic component:

mikroglas module at your choice

Rotary pump (educts):

number of pumps: 2
material of pump head: ceramic
flow rate of educt: 0.1 - 45 ml/min.
max. pressure: 7 bar

Gear pump (heater / chiller):

number of pumps: 1
gear wheels: Ryton
seal: Teflon
flow rate: 6.0 - 560 ml/min.
Max. pressure: 5.2 bar

Valves:

function: 3 ways, nonreturn, pressure relief
material: PVDF or PEEK
sealing material: FFKM

Sensors:

temperature: Glass-encapsulated Pt100 elements
pressure: piezoceramic up to 10 bar
housing: PEEK

Heater / chiller:

temperature range: -20°C up to 120°C

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Microreaction System ***mikro***Syn II

mikroglas

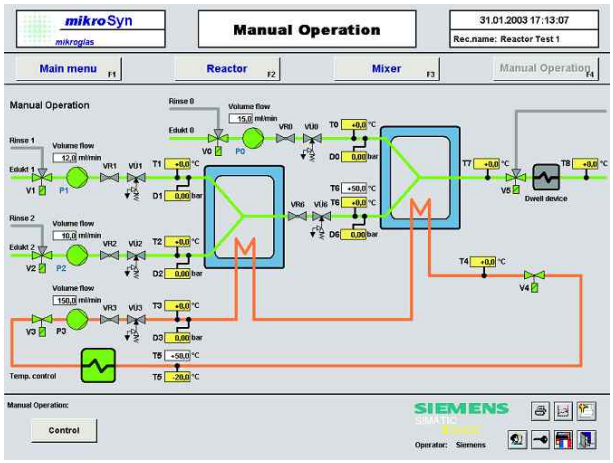
The system is designed to run two chemical reactions in series! It consists of 3 rotary pumps, 2 gear pumps, valves, pressure and temperature sensors. The heating/cooling circulation is tempered by a Huber polystat. The microreaction system is controlled by a SIMATIC S7-300 Control System by Siemens.

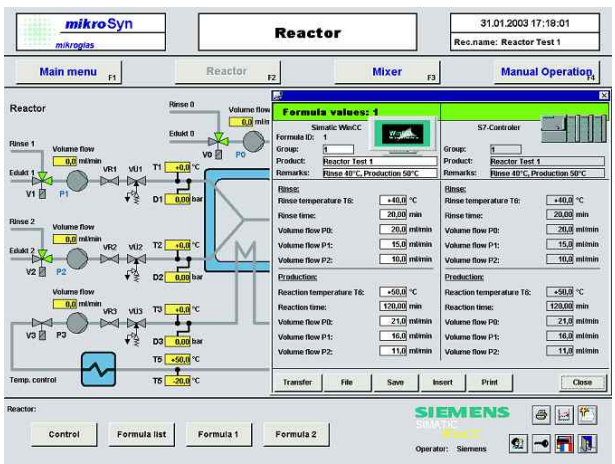
Box:

outer dim.: 700 mm x 700 mm x 330 mm
weight: approx. 30 kg

Control System:

The control system enables the user to adjust all parameters by a user interface. When running in manual mode all settings can be made by free choice. It is also possible to store the parameters in a file. This can be loaded, edited and executed to generate different programs. All measured data are available online and can also be printed or exported to a file.





Microfluidic components:

mikroglas modules at your choice

Rotary pump (educts):

number of pumps: 3
material of pump head: ceramic
flow rate of educt: 0.1 - 45 ml/min.
max. pressure: 7 bar

Gear pump (heater / chiller):

number of pumps: 2
gear wheels: Ryton
seal: Teflon
flow rate: 6.0 - 560 ml/min.
max. pressure: 5.2 bar

Valves:

function: 3 ways, nonreturn, pressure relief
material: PEEK
sealing material: FFKM

Sensors:

temperature: Glass-encapsulated Pt100 elements
pressure: piezoceramic up to 10 bar
housing: PEEK

Heater / chiller:

temperature range: -20°C up to 120°C

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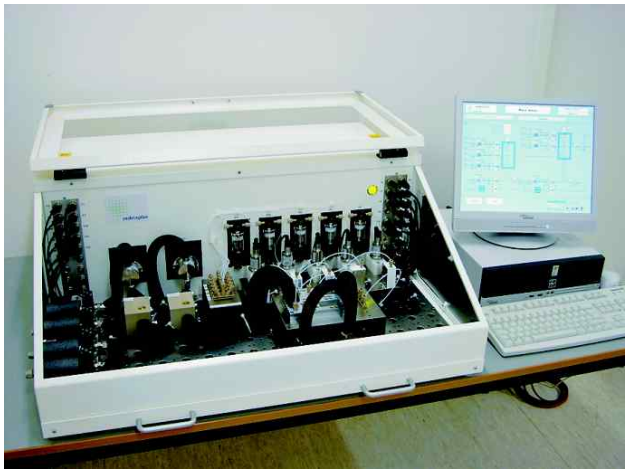
Microreaction System ***mikro***Syn µFlow

The ***mikro***Syn µFlow system is designed to carry out chemical reactions in continous flow with very low flow rates between 1 µl/min up to 1 ml/min. The system gives excellent control of reaction conditions and can be used for synthesis and reaction optimization. The system consists of syringe pumps for the feed streams and gear pumps for the heating/cooling liquid. Furthermore it contains additional equipment like valves and pressure and temperature sensors. The heating/cooling circuit is tempered by a Huber polystat. The microreaction system is controlled by a SIMATIC S7-300 Control System by Siemens.

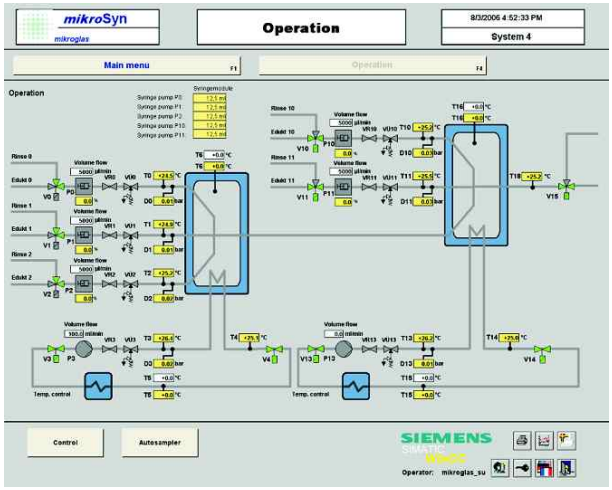
Box:

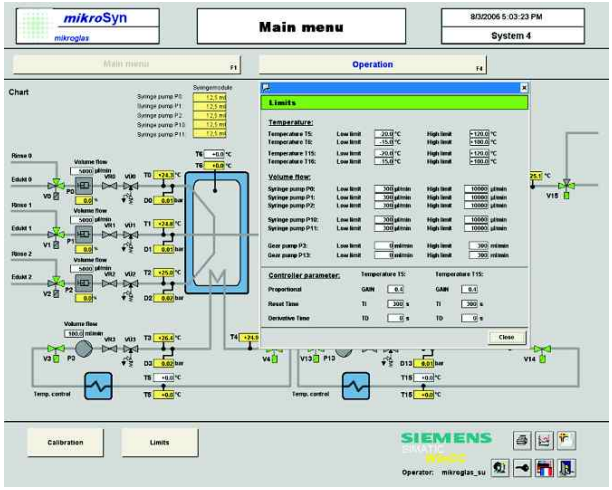
outer dim.: 850 mm x 680 mm x 340 mm
weight: approx. 30 kg



Control System:

The control system enables the user to adjust all parameters by a user interface. When running in manual mode all settings can be made by free choice. It is also possible to store the parameters in a file. This can be loaded, edited and executed to generate different programs. All measured data are available online and can also be printed or exported to a file.





Microfluidic component:

mikroglas module at your choice

Syringe pump (educts):

number of pumps: 3 up to 5
flow rate of educt: 1 - 1000 µl/min.
max. pressure: 6 bar

Gear pump (heater / chiller):

number of pumps: 1 or 2
gear wheels: Ryton
seal: Teflon
flow rate: 6.0 - 560 ml/min.
Max. pressure: 5.2 bar

Valves:

function: 3 ways
material: PVDF or PEEK
sealing material: FFKM

Sensors:

temperature: Glass-encapsulated Pt100 elements
pressure: piezoceramic up to 10 bar
housing: PEEK

Heater / chiller:

temperature range: -20°C up to 120°C

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mikroglas

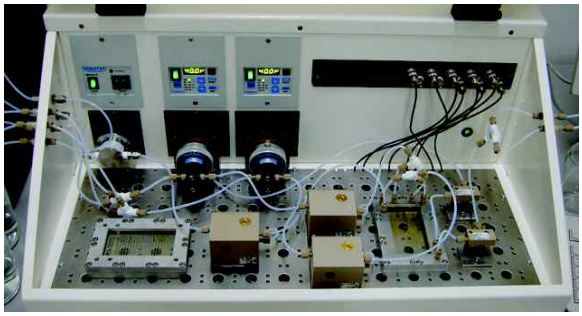
mikroSyn EDU - microreaction system for research and EDUcation

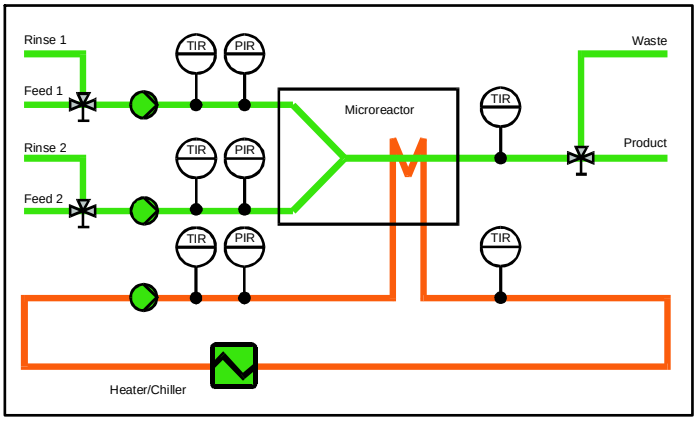
mikroSyn EDU is especially designed for university research and education with a low budget for investments.

The system is designed to run a microreaction modul under controlled conditions.

The system consists of 2 rotary piston pumps and 1 gear pump, valves, pressure and temperature sensors. The temperature of the heating/cooling circuit can be controlled with an optional Huber polystat.

Due to the ease of use, the ***mikro***Syn EDU shows a high flexibility for research tasks. All modules have electrical input/output ports to collect data during operation.





Microreactor (optional):
mikroglas module at your choice

Rotary piston pump (educts):
number of pumps: 2
material of pump head: ceramic
flow rate of educt: 0.1 - 45 ml/min.
max. pressure: 7 bar

Gear pump (heater / chiller):
number of pumps: 1
gear wheels: Ryton
seal: Teflon
flow rate: 6.0 - 560 ml/min.
max. pressure: 5.2 bar

Tubings:
material: PTFE fluoroplastic

Valves:
function: 3 ways
material: PTFE fluoroplastic

Sensors:
temperature: Glass-encapsulated Pt100 elements
pressure: piezoceramic up to 10 bar
housing: PEEK

Heater / chiller (optional):
temperature range: -20°C up to 120°C

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Microreaction System ***mikro***Syn **IR**

mikroglas

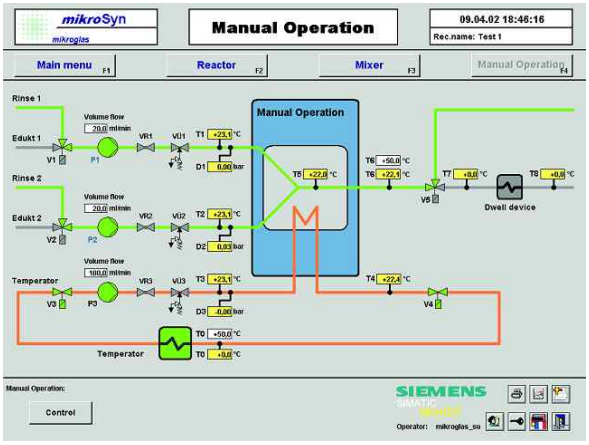
The system consists of 2 rotary pumps, 1 gear pump, valves, pressure and temperature sensors. The heating/cooling circulation is tempered by a Huber polystat. The microreaction system is controlled by a SIMATIC S7-300 Control System by Siemens. Additionally an infrared spectrometer is connected to monitor the product quality online.

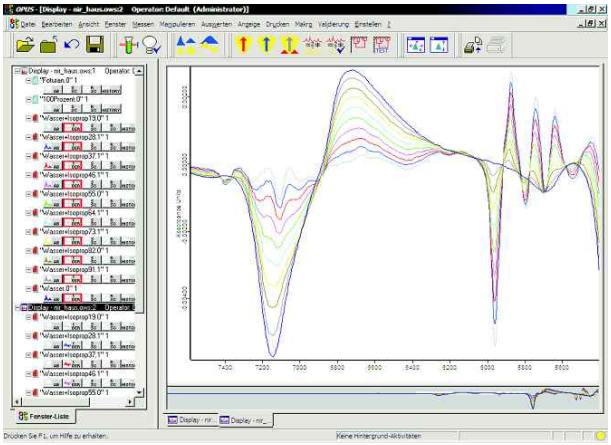
Control System:

The control system enables the user to adjust all parameters by a user interface. When running in manual mode all settings can be made by free choice. It is also possible to store the parameters in a file. This can be loaded, edited and executed to generate different programs. All measured data are available online and can also be printed or exported to a file.

Online Process Control by FT-IR Spectroscopy:

The FT-IR spectroscopy enables the user to analyze the chemical parameters and the product quality during the reaction online. It is possible to work with both systems, near infrared (N-IR) and mid infrared (M-IR) for different tasks. The main goal is the permanent control over the process which allows to adjust the settings and to optimize the process in a very short time.





System: Water / Isopropanol

Developed in cooperation with: BRUKER Optics

Microfluidic component:
mikroglas module at your choice

Rotary pump (educts):
number of pumps: 2
material of pump head: ceramic
flow rate: 0.1 - 45 ml/min.
max. pressure: 7 bar

Gear pump (heater / chiller):
number of pumps: 1
gear wheels: Ryton
seal: Teflon
flow rate: 6.0 - 560 ml/min.
max. pressure: 5.2 bar

Valves:
function: 3 ways, nonreturn, pressure relief
material: PVDF or PEEK
sealing material: FFKM

Sensors:
temperature: Glass-encapsulated Pt100 elements
pressure: piezoceramic up to 10 bar
housing: PVDF or PEEK

Thermostat:
temperature range: -20°C up to 120°C

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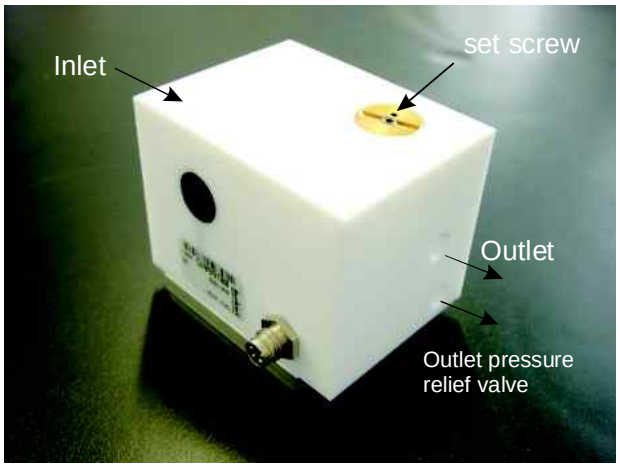
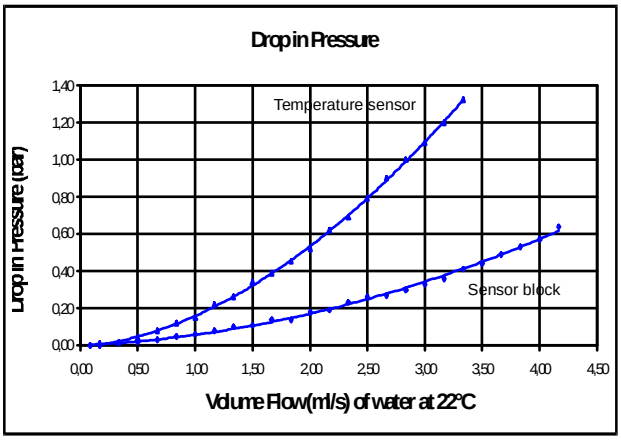
mikroglas sensors

mikroglas chemtech GmbH develops and manufactures microtechnological products made of glass (FOTURAN). The material glass makes the reactor modules resistant against aggressive media. For this reason the material properties of the sensors were adapted to the system. The sensor block with integrated pressure- and temperature sensor is used to monitor the media supply of the micro reactor. Thereby the pressure and the temperature is measured directly in the liquid flow. The sensor block contains in addition a nonreturn valve and a pressure relief valve. With the help of a set screw the pressure relief valve can be adjusted manually to a limit value.



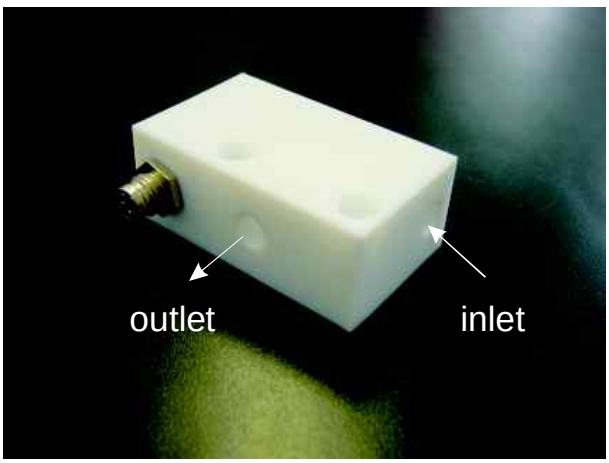


Specifications sensor block

Housing material	PTFE
Contacting material	Aluminium oxide ceramic (99% Al2O3), Glass, Simriz, Kalrez, FFKM
Volume flow	approx. 550 l/h gasflow at 1 bar inlet pressure and free outflow
Internal Volume	1.0 ml
Temperature	-40°C up to +125°C
Temperature sensor	Pt 100
Pressure sensor:	
Measurement range	0...10 bar
Auxiliary energy	12...30 V DC
Output signal	4...20 mA
Compensating temperature	-40°C ...+80°C
Characteristic curve	linear
Outer dimension	50 mm x 50 mm x 65 mm
Connections	by ready-made Teflon tubes (UNF thread 1/4“)

Specifications temperature sensor

Housing material	PTFE
Contacting material	Glass, Simriz, FFKM, Kalrez
Volume flow	approx. 550 l/h gasflow at 1 bar inlet pressure and free outflow
Internal Volume	0.25 ml
Temperature sensor	Pt 100
Temperature range	-40°C up to +125°C
Outer dimension	20 mm x 30 mm x 50 mm
Connections	by ready-made Teflon tubes (UNF-thread 1/4“)



Developed in cooperation with
Buerkert GmbH & Co. KG

Company profile

mikroglas chemtech GmbH, is based in Mainz, Germany and was established in February 2004. Its employees have more than 8 years of experience with the fabrication of micro-technological products made of glass. Because of its outstanding properties, glass offers a wide range of opportunities in micro-technology. ***mikroglas*** mainly works with a photoetchable glass from Schott called FOTURAN. Typical products are sensors, components for electronic devices, micro-titerplates, as well as microreactors and systems for the production of chemical and pharmaceutical products. ***mikroglas*** can offer to the customer its know-how in designing and producing microfluidic devices, as well as building laboratory equipment, including e.g. sensors, pumps, safety features and testing of the central devices.
For production the most modern facilities of microtechnology are available. The technical equipment covers photo-lithographic devices, furnaces, wet etch benches, cleaning equipment, screen printing systems, as well as devices for quality assurance. The newest micro-structurization technology available at ***mikroglas*** is the laser processing of glass in a true 3D direct writing process. ***mikroglas*** also has equipment for mechanical glass handling, e.g. for grinding, lapping, polishing, sawing, etc. Additionally, different coatings of the glasses can be executed, e.g. thin film deposition of metals, electroplating, and bio-coating.

Products:

- FOTURAN, photoetchable glass
- microreaction technology: mixers, microreactors, heat exchangers, microreaction systems
- biotechnology: e.g. microtiterplates, lab-on-chip components
- sensoric: e.g. gas sensors
- display technology: components for FED, e.g. spacers

R&D:

- new products based on glass for microtechnological applications
- microfluidic devices made from glass, e.g. microreactors
- components for applications in biotechnology
- spacers for display technology

Services:

- glass structurization (customized)
- advice on effective use of microcomponents made of glass
- development of new products
- prototyping
- large scale poduction

Current Corporate Partners

mikroglas works closely together with research institutes, e.g. Institute for Microtechnology, Mainz in Germany, all major german and international chemistry companies as well as young and innovative biotechnology companies. ***mikroglas*** has managed to build up a world-wide sales network . Our representatives are located in the European, US and Asian markets.

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