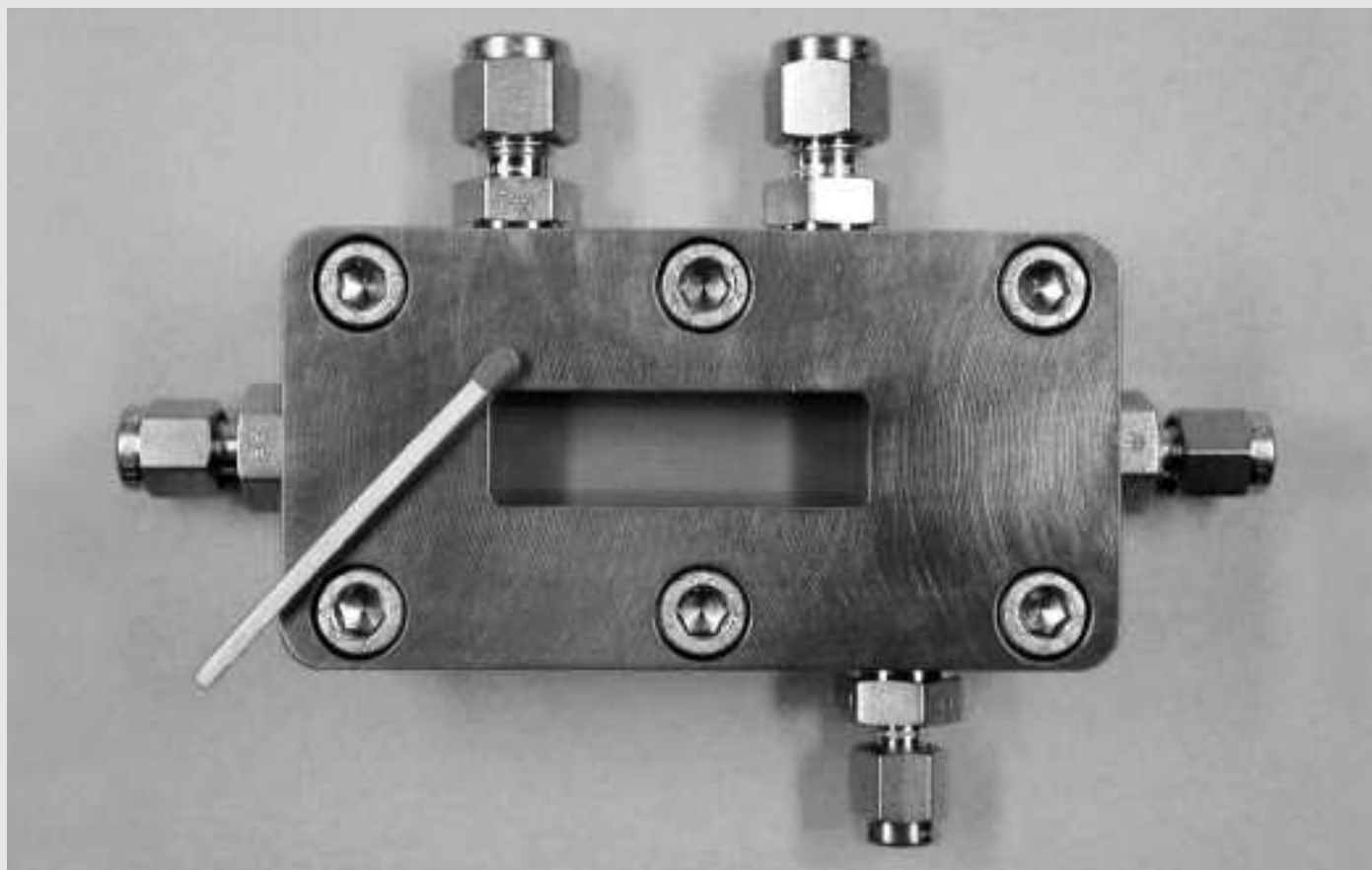


MICRO BUBBLE COLUMN

MBC



Micro Bubble Column

Principle

The Micro Bubble Column performs disperse-type gas/liquid contacting, similar to its macroscopic analogue. The flow patterns, however, resemble those of flow in small-channel monoliths, such as slug, annular or spray flow, whereas the bubbly flow known for bubble columns is found only in small region of stability.

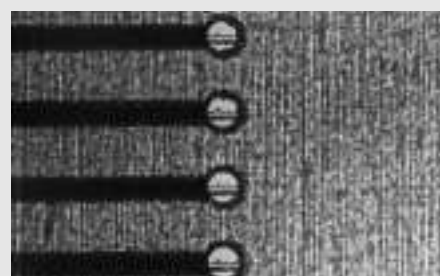
The Micro Bubble Column is a gas/liquid contacting device for very rapid reactions, typically in the order of one second and below. The strength of this device is the possibility to switch between all these distinct flow patterns, by virtue of changing gas and liquid superficial velocities. The information to do so has been thoroughly documented in flow-pattern maps of various types such as Baker charts. In the two most prominent flow patterns, the slug and annular ones, mass transfer from gaseous to liquid phase is strongly enhanced via using very thin ($\sim 50 \mu\text{m}$) liquid films.

The Micro Bubble Column has an inspection window for monitoring flow patterns. An integrated heat exchanger serves for proper temperature control. The mixing device is made via UV lithography/electroforming with gas feed channels' dimensions down to $3 \mu\text{m}$ to achieve equipartial gas distribution within the parallel channels.

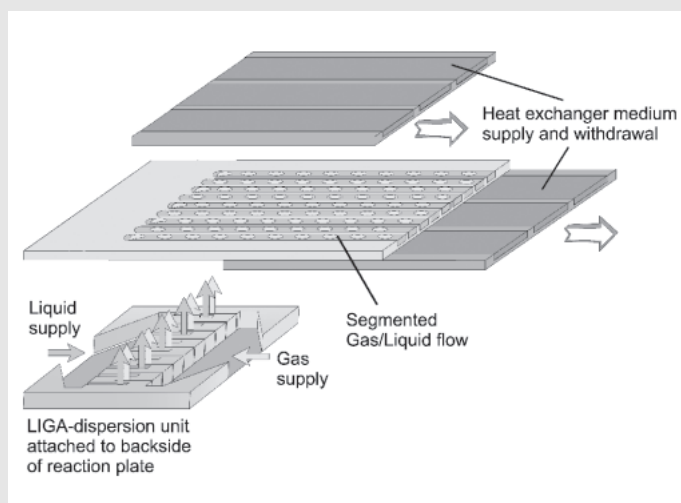
The high mass and heat transfer of the Micro Bubble Column were outlined by performing direct fluorination of toluene with elemental fluorine. This so far uncontrollable and highly explosive reaction could be managed under safe conditions and with control over reaction mechanism. Via an electrophilic pathway, a yield of 20% of o- and p-mono-fluorinated isomers was achieved. Fundamental studies on mass transport were carried out using the carbon dioxide conversion in alkaline media. It turned out that higher space-time yields are achievable than in conventional packed columns.



Gas/liquid UV-LIGA contacting unit



Row of outlet holes for separate multi-phase flow in reaction channels



Principle of gas/liquid flows in MBC



Disassembled Micro Bubble Column MBC

Technical Data

Name	Micro Bubble Column
Order number	MBC
Size (L x B x H)	95 x 50 x 36
Connectors (Inlet/Outlet)	1/8" / 1/8"
Material	1.4571 for housing and reaction plate Nickel (LIGA) for micro dispersion unit Copper for cooling plate Borofloat glass for inspection glass
Size of micro dispersion unit (μm)	7 x 20 x 600 for gas (64 channels) 20 x 20 x 600 for liquid (64 channels)
Size of reaction channel plate	Width: 200 μm Depth: 70 μm Length: 60.5 mm
Size of cooling channels (mm)	Width: 3 Depth: 0.5 Length: 40

Operating Conditions

Temperature ($^{\circ}\text{C}$)	180
Pressure stability (bar)	30
Flowrate (ml/h)	5 – 100
Residence time (s)	0.14 – 0.56
Liquid film thickness (μm)	30 – 70
Leakage Class	L _{0.01}