

Gas Bubble Generation in Mineral Oil

Dolomite's Droplet Generation System - Large Droplets



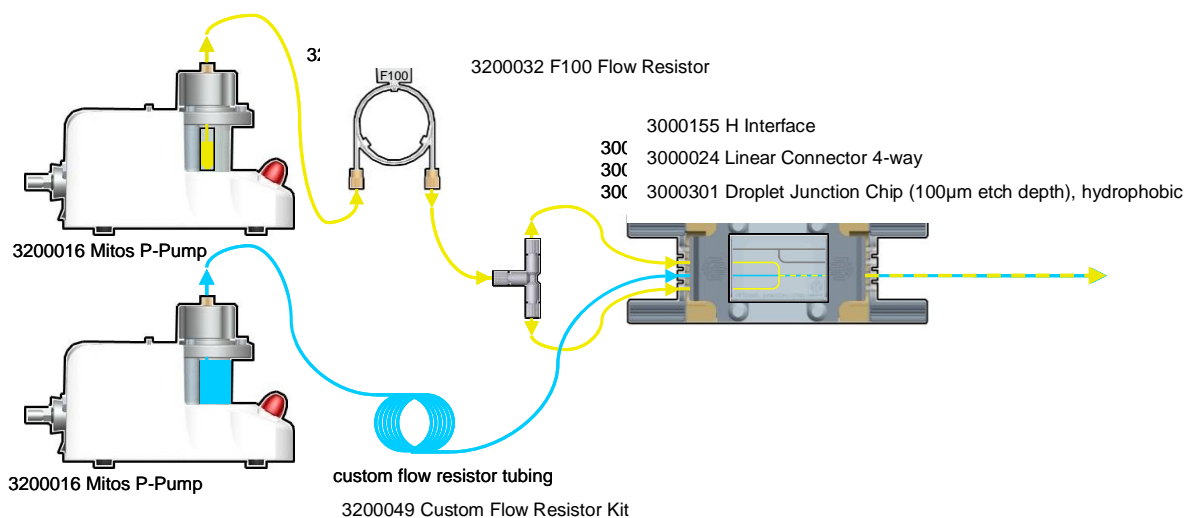
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Introduction

Gas bubble generation on microfluidic chips is useful for the production of foams with micrometer sized gas bubbles dispersed in a liquid. Research in this field is enabling the development of advanced materials for science and industry. For many applications, it is important to generate monodisperse bubbles to obtain foams with consistent characteristics. This application note presents the Dolomite's Large Droplet Generation System and Droplet Junction Chip for the generation of monodisperse gas bubbles.

Gas Bubble Generation Test Set-up

Gas was delivered to the chip using a Mitos P-Pump (Part No. 3200016) and Custom Flow Resistor Kit (Part No. 3200049) to bring the gas into the required flow rate range. The flow resistor interfaced directly into the Droplet Junction Chip (100 μ m etch depth), hydrophobic (Part No. 3000301) to minimize the compressible volume downstream. A second Mitos P-Pump provided the carrier mineral oil flow into the chip via an F100 Flow Resistor (Part No. 3200032). A high speed digital microscope (Part No. 3200531) captured the gas bubble generation and the bubble monodispersity was measured using image analysis software. The gas used was compressed air and the carrier liquid was mineral oil with 5% v/v Span 80 (Span 80 is a surfactant used to increase droplet stability).



Experimental set-up for the generation of monodisperse gas bubbles on the Mitos droplet junction chip - hydrophobic with flow provided by the Mitos P-Pump.

Results

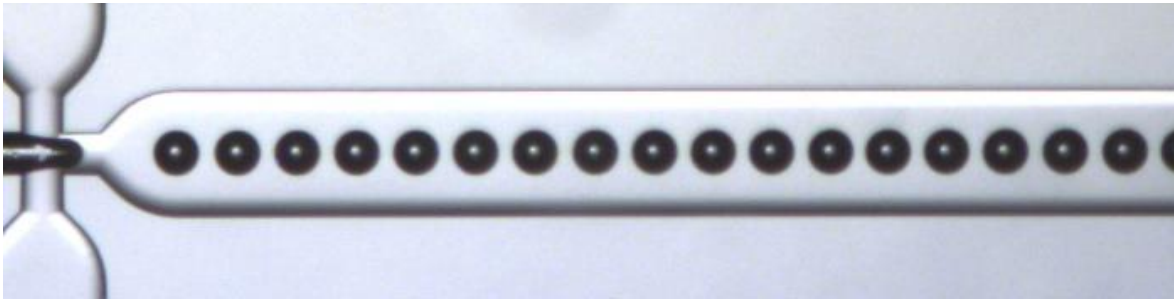
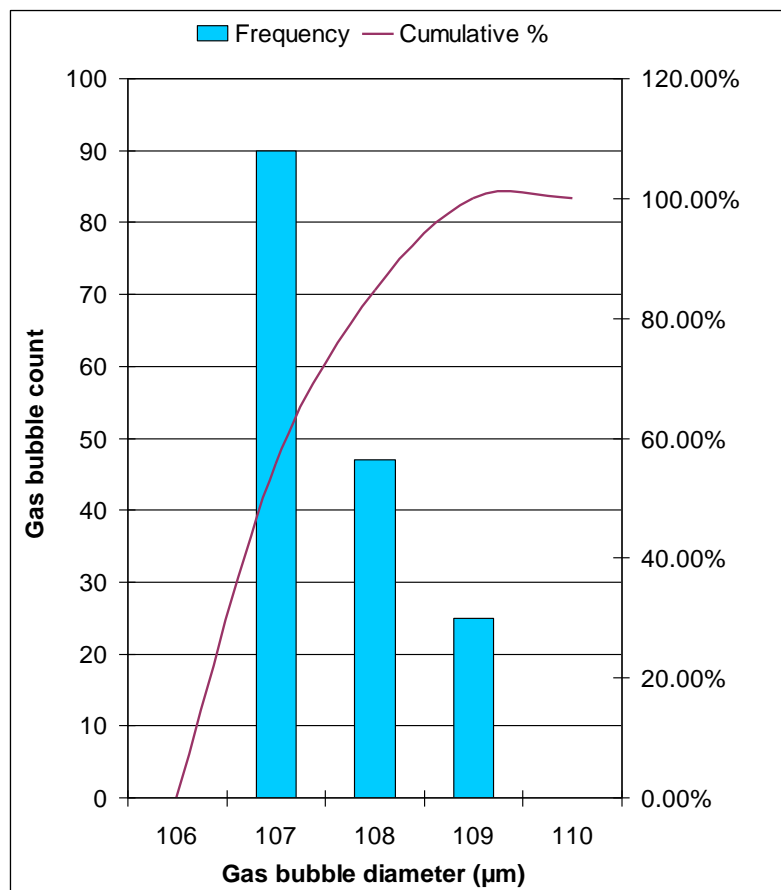


Image of compressed air bubbles (flow rate 2.1 $\mu\text{l}/\text{min}$) in a carrier phase of mineral oil with 5% v/v Span 80 (flow rate 16 $\mu\text{l}/\text{min}$) formed on the Mitos Droplet Junction Chip – Hydrophobic.



Histogram of gas bubble size distribution with compressed air flow rate of 2.1 $\mu\text{l}/\text{min}$ and mineral oil with 5% v/v Span 80 flow rate of 16 $\mu\text{l}/\text{min}$. Sample data obtained with test set-up described above and processed using image analysis software.



Measure of Distribution	Value
Mean Droplet Diameter	106.9 μm
Standard Deviation	0.7 μm
Minimum Droplet Diameter	106.4 μm
Maximum Droplet Diameter	108.9 μm
Coefficient of Variation	0.7 %

Table showing variation in gas bubble size.

Conclusions

Highly monodisperse gas bubbles have been successfully generated on the Droplet Junction Chip (100 μm etch depth), hydrophobic. Monodispersity was achieved with the pulseless pressure pump technology of the Mitos P-Pump. This demonstration provides a test system and initial operating conditions for research into foam production using the Dolomite's Large Droplet Generation System.

The Dolomite's Large Droplet Generation System presented in this application note is available with different junction sizes and surface coatings (hydrophilic, hydrophobic and fluorophilic) for the generation of gas bubbles, water-in-oil droplets and oil-in-water droplets. Details in the Appendix below.

Appendix: System Component List

Part No.	Part Description	#
3200675	Dolomite's Droplet Generation System - Large Droplets The system includes:	-
	Mitos P-Pumps	2
	Sensor Displays *	2
	Flow Rate Sensors *	3
	High-Speed Digital Microscope	1
	Valves, Chip Interfaces, Fittings and Tubing	-
	Mitos Compressor 6bar	1
3000158	Droplet Junction Chip (100µm etch depth)	1
3000436	Droplet Junction Chip (190µm etch depth)	1
3000301	Droplet Junction Chip (100µm etch depth), hydrophobic	1
3000437	Droplet Junction Chip (190µm etch depth), hydrophobic	1
3200506	Droplet Junction Chip (190µm etch depth), fluorophilic	1
3200512	Droplet Junction Chip (100µm etch depth), fluorophilic	1
	Installation and Training	-

- * The Flow Rate Sensors are compatible with the Mitos P-Pumps. The Mitos P-Pump communicates directly with the Flow Sensors to adjust the pressure and achieve the desired flow rates. The flow rates can be easily set using the Flow Control Centre Software working in flow mode rather than pressure mode (as described in the application note). Each Sensor Display can be used interchangeably with the Flow Rate Sensors. The sensors simply attach with a push-click action.