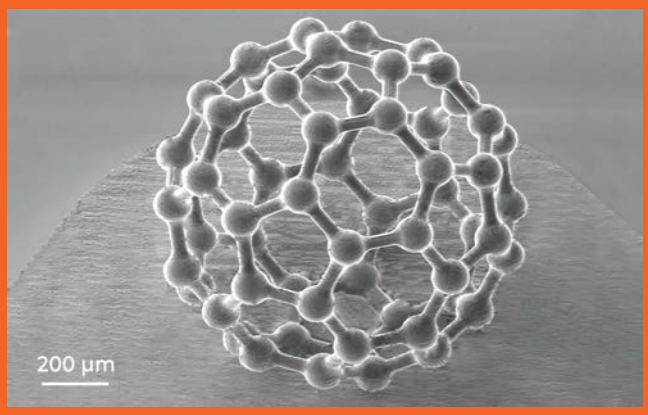
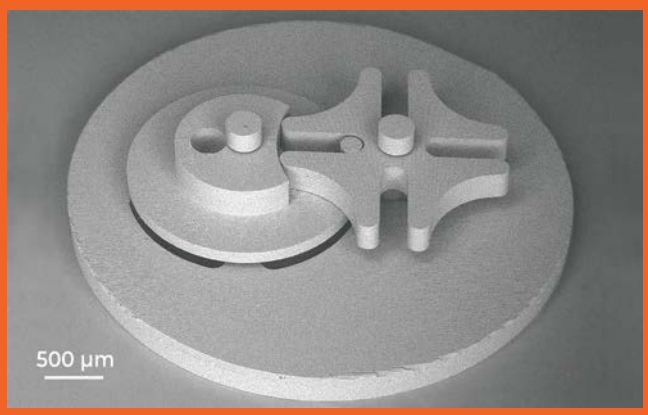
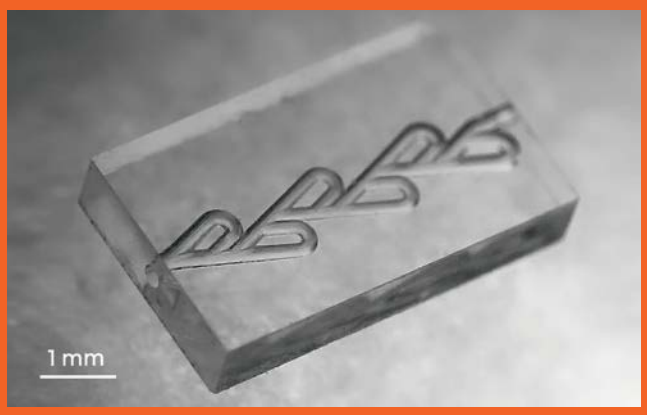


3D Glass Structures

3D Nozzle

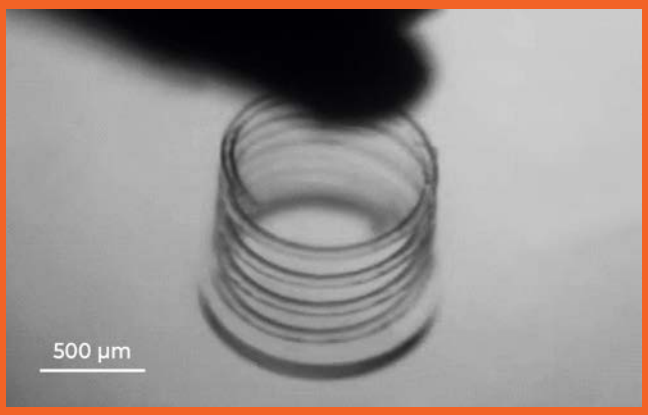


Geneva Gear



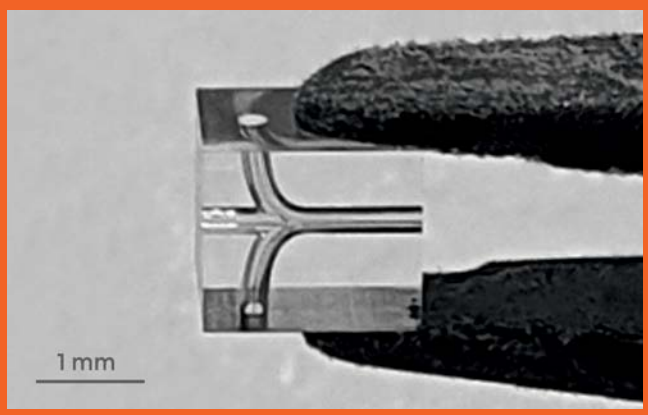
Tesla Valve

Micro Channels Formation



Threads for Screw

3D Gears Mechanisms



3D Interconnect Channels

SELECTIVE LASER ETCHING

APPLICATIONS

- Micro-mechanics
- Micro-fluidics
- LAB-ON-CHIP

FEATURES

- Subtractive manufacturing technique
- Arbitrary-shaped 3D structures from glass µm to cm scale
- Various glasses applicable
- Self-alignment system for automatic laser beam alignment
- Micrometer feature resolution

Selective laser etching (SLE) is a subtractive laser technology allowing fabrication of complex-shape 3D glass parts with micrometer precision. This technology consists of two fabrications steps: femtosecond laser irradiation and subsequent chemical etching. Tightly focused femtosecond laser beam induces modifications of transparent material within the focal point of laser beam. By spatially moving the laser focus well-defined structure is written in point-by-point fashion up to substrate surface. Afterward, the sample is immersed in etchant solution, which etches out laser modified areas.

SLE is often used in the manufacturing of electronic devices and other precision components, as it allows for high levels of accuracy and detail in the etched patterns. Additionally, because the laser beam is highly focused, it can be used to etch very small and intricate designs.

SPECIFICATIONS

Technology	Substractive manufacturing
Materials	Fused silica, Borofloat 33
Smallest feature size	> 1 µm
Minimum surface roughness	< 200 nm
Maximum object height	1 cm
Aspect ratio	> 1 : 200
Minimum micro hole diameter	5 µm
Writing speed	50 mm/s

TECHNICAL SPECIFICATIONS

Technology		Multiphoton Polymerization			Selective Laser Etching	Hybrid
LASER SOURCE						
Femtosecond laser	Wavelength	780 nm	1030 ± 10 nm 515 ± 10 nm		1030 ± 10 nm	1030 ± 10 nm and 515 ± 10 nm
	Repetition rate	100 MHz	11 MHz ... 76 MHz	Single-shot – 1 MHz	Single-shot – 1 MHz	Single-shot – 1 MHz
	Pulse duration	< 100 fs	50 fs 120 fs 170 fs	290 fs – 20 ps (tunable)	250 fs (450 fs) – 10 ps (tunable)	190 fs – 10 ps (tunable)
	Max. average power	250 mW	2 W	5 W	10 W	from 5 W to 20 W*
	Long-term power stability	< 0.5% RMS over 24 h	< 0.5% RMS over 100 h			
POSITIONING						
Linear stages with synchronized Galvano scanners	XYZ POSITIONING STAGES MOUNTED ON GRANITE BASE WITH BRIDGE					
	Travel (XYZ)	160 mm × 160 mm × 60 mm *				
	Accuracy (XYZ)	± 300 nm				
	Resolution (XYZ)	1 nm				
	Maximum speed (XY)	200 mm/s				
	GALVANO SCANNERS					
	Accuracy	50 µrad				
	Repeatability	0.4 µrad RMS				
OTHER PARAMETERS						
Monitoring on time		The fabrication process is monitored by an integrated machine vision system				
Stitching		Stitchless fabrication using Infinite Field of View (IFoV)				
Focusing optics		Objectives – from 0.4 to 1.4 NA *			Objectives – from 0.25 to 0.45 NA *	Objectives – from 0.25 to 1.4 NA *
Autofocus system		Automatic glass/polymer or glass/air interface optical detection				
Self-Align-System (SAS)		Automatic laser beam path alignment system				
Substrate		Universal vacuum sample holder with computer-controlled, position synchronized illumination for transparent samples				

Technology	Multiphoton Polymerization	Selective Laser Etching	Hybrid

Beam delivery & control	Motorized attenuator, polarization rotator, beam expander. Integrated power meter enables real-time power monitoring
Software	Convenient control of all necessary process parameters and machine settings. The software handles standard formats of 3D designs created by popular CAD programs, like STL
Laser safety	Ergonomic housing to ensure laser safety class 1 and environment stability conditions for laser microfabrication process

* Customizable.

PHYSICAL DIMENSIONS

Dimensions when all doors are closed (W × L × H)	1790 mm × 920 mm × 2270 mm
Dimensions when doors are opened (W × L × H)	2680 mm × 1900 mm × 2300 mm
Weight	~ 700 kg

ENVIRONMENTAL & UTILITY REQUIREMENTS

Operating temperature	20 °C ± 2 °C
Relative humidity	≤ 60%
Electrical requirements	110 V AC, 20 A – 230 V AC , 10 A
AC power (normal operation)	typical 2 kW

The conditions of the environment are preferred to be as stable as possible.

DRAWINGS

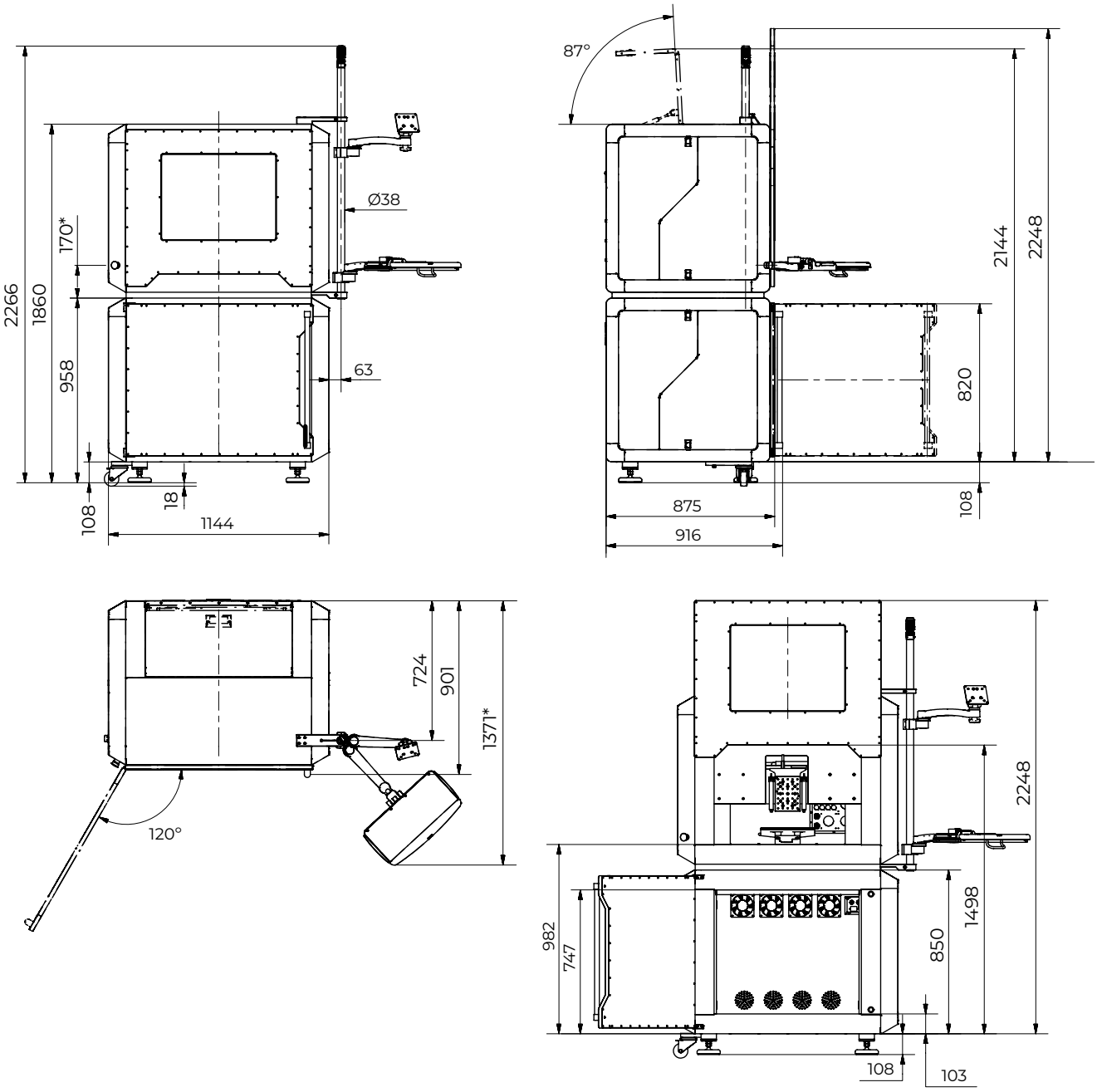


Figure 1. Laser Nanofactory dimensions in milimeters

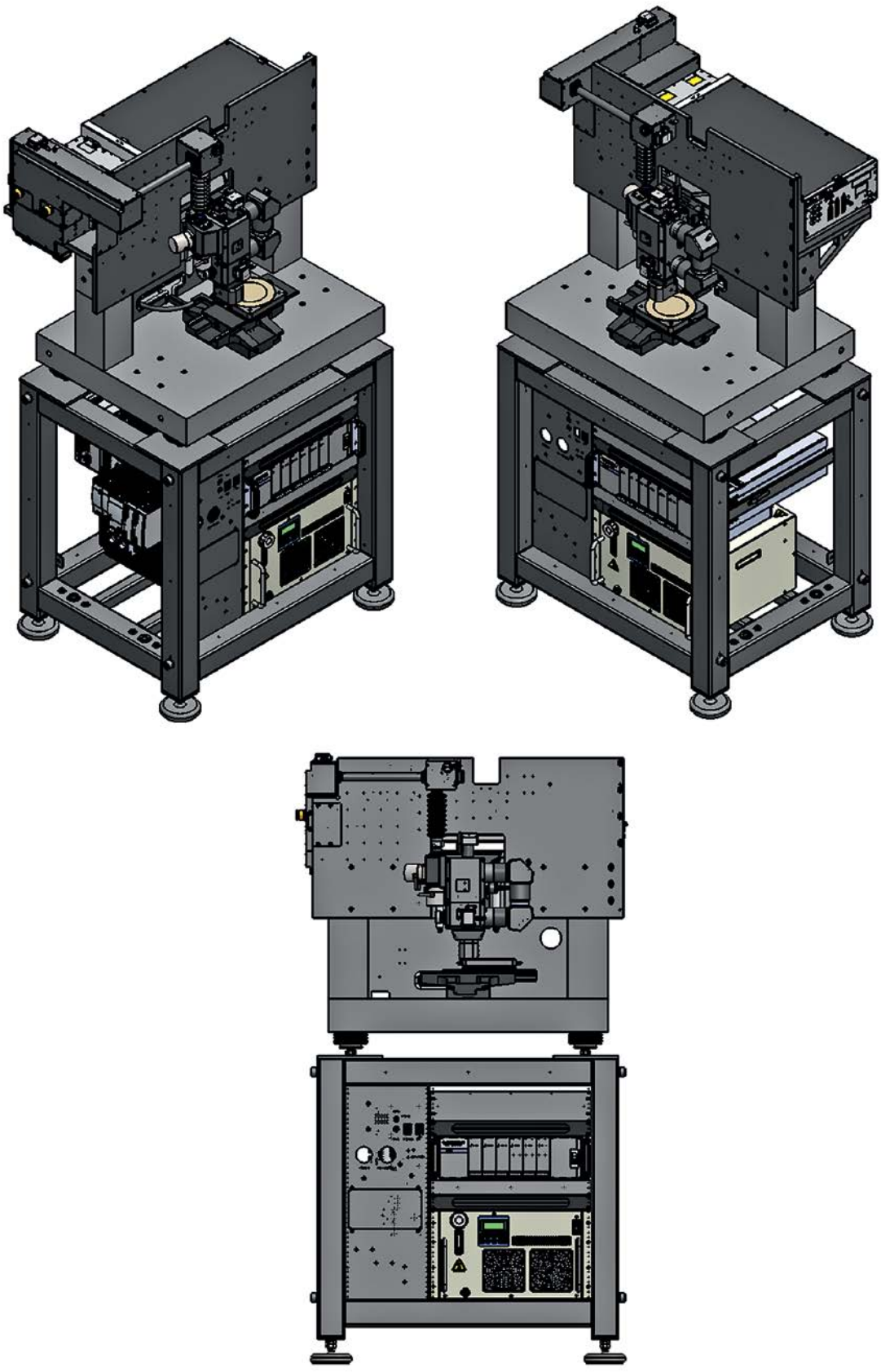


Figure 2. Laser Nanofactory drawings