MULTIPHOTON POLYMERIZATION

APPLICATIONS

- Micro-optics
- Micro-mechanics
- Scaffolds
- Sensors
- Interconnects

FEATURES

- Nanometer resolution additive manufacturing technique
- True 3D structures in micrometer scale
- Various polymers available
- Stitching error-free manufacturing

Multiphoton-polymerization (MPP) is a technology that enables the production of arbitrary shape polymeric structures within submicrometric resolution. First, a photoresist sample is prepared by drop-casting polymer material mixed with a photoinitiator on the glass slide and then pre-baking. Afterward, the 3D microstructure is fabricated using a direct laser writing technique. Consequently, the polymer hardens in places of drop where it is affected by laser radiation due to a process called photopolymerization. Finally, the microstructure is immersed in an organic solvent to develop an unpolymerized photoresist.

MPP is often used in the manufacturing of microelectronic devices, as it allows for the creation of very small and detailed structures with high levels of precision. Additionally, because the light is highly focused, it can be used to create complex 3D shapes.

SPECIFICATIONS

Technology	Additive manufacturing
Materials	SZ2080, SU-8, Ormocers, Glassomer, hybrid organic-inorganic photopolymers, elastomers, proteins
Minimum XY feature size	150 nm
Minimum surface roughness Ra	≤ 20 nm
Maximum fabrication speed	30 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

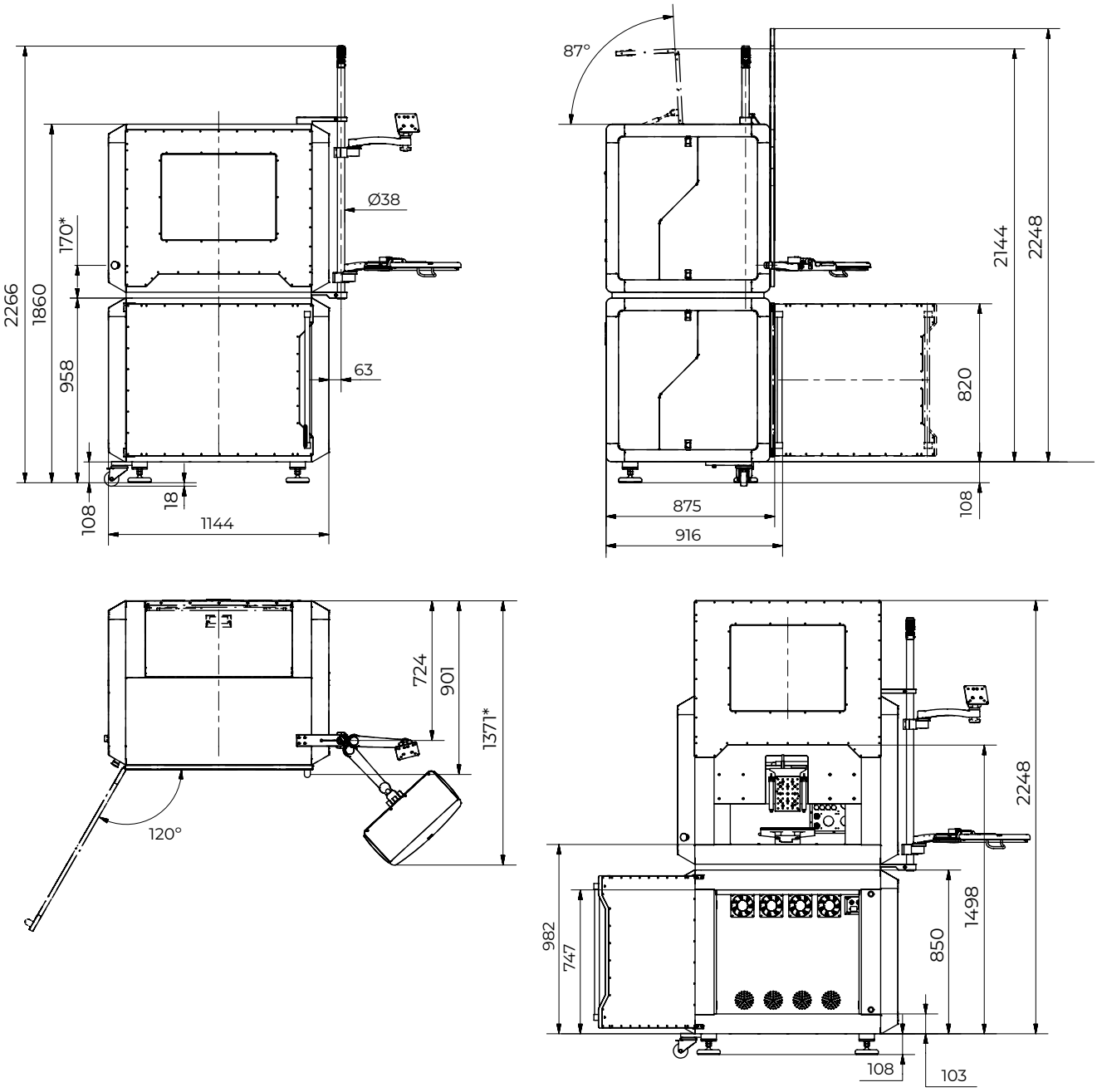

Figure 1. Laser Nanofactory dimensions in milimeters

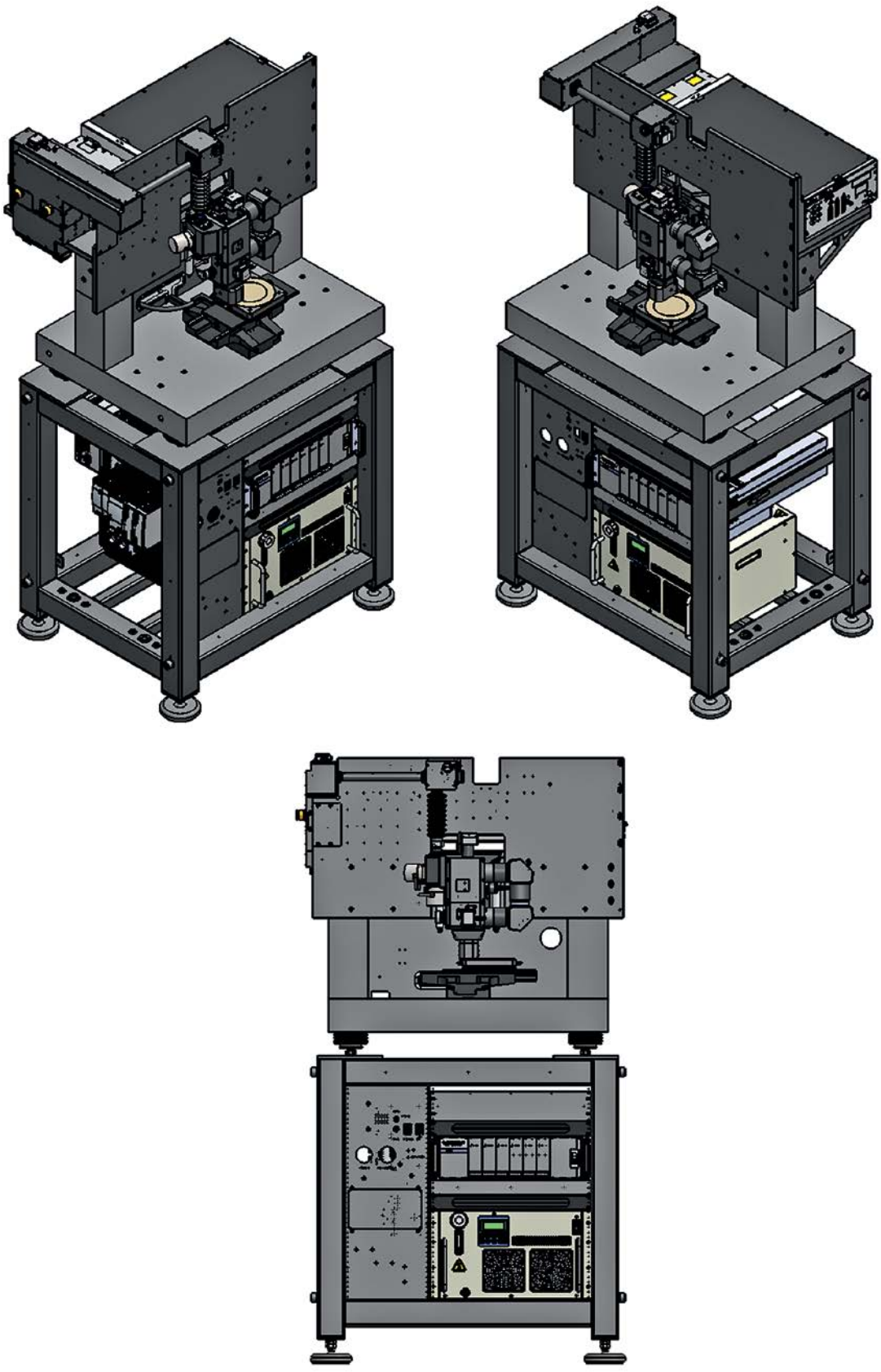

Figure 2. Laser Nanofactory drawings