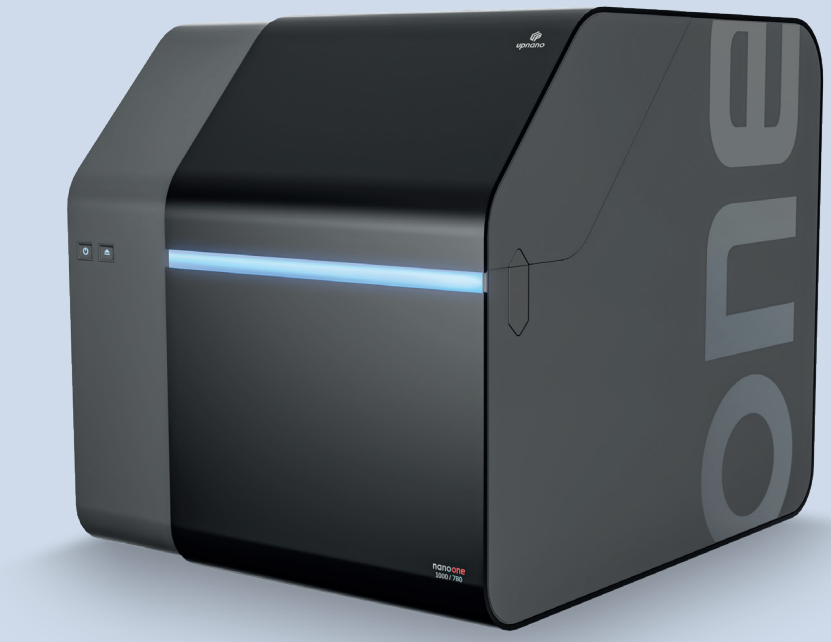
nanoONE

The highest performance 2-photon polymerization 3D printing systems with a resolution below 100 nm



upnano

Upscaling nanofabrication

As an innovation leader in the field of high-resolution 3D printing, we see it as our mission to upscale nanofabrication.

UpNano is a high-tech company with a focus on development, manufacturing and commercialization of high-resolution 3D printing systems.

The state-of-the art NanoOne platform series is based on 2-photon polymerization, abbreviated as 2PP, which offers industry-leading speed and resolution below 100 nm.

UpNano is committed to providing customers with a comprehensive package of hardware, software and optimized printing resins.

The systems are used for the fabrication of polymeric microparts as well as the unique possibility of bioprinting in a native cell environment.

Using UpNano's cutting-edge technology makes it possible to print objects with sizes ranging from the sub-micrometer to the centimeter range and create 3D structures beyond 40 mm in height – with unprecedented printing speed.

Quality and environmental awareness are two fundamental prerequisites, which are reflected in the ISO 9001 and 14001 certifications of our company.

nanoONE

A platform technology

The NanoOne platform is the highest performing 3D printing system available. It combines the precision of 2-photon polymerization with unmatched high throughput.

This incredibly compact benchtop system is the right choice for scientific research approaches and multi-user facilities. A throughput of more than 450 mm^3 per hour also allows for batch and small series production of industrially applied microparts.

Hardware

think3D

Software

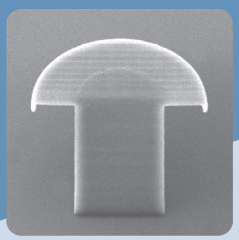
Resins

The technology is uniquely suited to address the trend towards miniaturization. This 3D printing system supports all branches of industry, from micro-optical and electronic components to microfluidic applications, medical technology, and cell research.

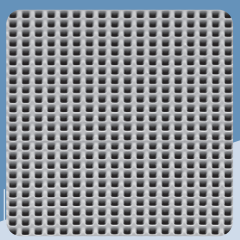
- Effective vibration isolation
- Built-in ISO6 cleanroom environment
- Operational in a natural-light environment
- Most powerful laser in its class available in 780 nm and 515 nm wavelength

Ultra-precise polymeric parts

Smallest details
The realization of detail <100 nm can be met with the high resolution of the NanoOne.

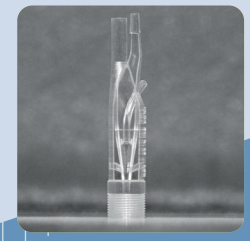


Surface elements
Periodic micro-elements and structures that influence the adhesive, optical, electronic, and sensory properties.

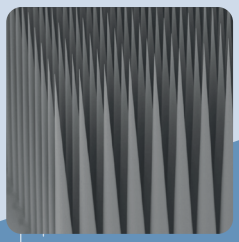


Filter systems
Filter structures with consistent pore size as small as 1 µm and versatile shape.

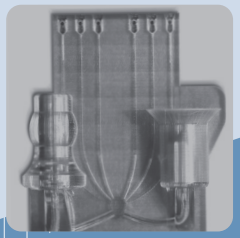
Castle on a pencil tip
Our well-known project demonstrates in an artful way how miniscule and precise 2-photon printed components can be.



Nozzles
Integrated micro-fluidic components with connectors and internal complex structural elements.



Microneedles
High-resolution needles with a tip size <1µm and unprecedented aspect ratios.



Microfluidics
Manufacturing entire chips with high-precision channel systems and large-volume connectors using optically transparent resins.

Polymer MEMS
Intricate, free-moving components with mechanical properties that are printable in a single process.

The perfect solution for your application

With three different model configurations, a NanoOne is the right solution for every application and customer – from printing macroscale components to classic 2PP applications. It also offers high-resolution bio-printing in the presence of living cells.

UpNano's 2PP printing systems enable our customers worldwide to overcome manufacturing barriers across multiple sectors. The NanoOne is creating entirely new solutions never before possible.

"Using NanoOne, we have reduced the production time for a microfluidic chip from many hours on our in-house tool to just minutes. The exceptional combination of high laser power, fine resolution and intuitive software was instrumental in achieving this remarkable speed boost. NanoOne has become an indispensable instrument, playing a pivotal role in numerous research projects at the Roche Institute of Human Biology. It greatly facilitates the prototyping of new microfluidic chips and the bioengineering of next-generation organ-on-chip models for various R&D projects at Roche. Looking ahead, we're already exploring avenues to further expand our capacity, and we're confident that we have the ideal partner by our side."

Dr. Mike Nikolaev, Scientist at Roche Institute of Human Biology

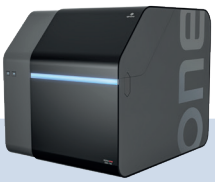
Roche
Institute of Human Biology

The Roche Institute for Human Biology (IHB) is leading the way in improving how we study human systems, from basic research to developing new drugs. Teams with different expertise work together across three main areas: Exploratory research, Bioengineering, and Translation. They use advanced technology to support their work. One important project involves making organoids (tiny models of organs) better and creating a system to store them. The Bioengineering team focuses on solving specific problems in drug development by creating new tools and tests. Another group, the Organoid Engineering team, is working on making organoids more realistic to help in studying diseases and treatments. They are looking at how to include different types of cells and how the immune system responds.

Find the NanoOne model suitable for your application

The UpNano experts can guide you to find the right system for your desired applications from the three NanoOne models available. The modular platform allows users to upgrade the system over time, adding capabilites as your research or business expands. For custom instrumentation, the NanoOne has over- and under-stage access ports.

nanoONE 250



The entry into the world of 2-photon-based 3D printing

This entry model is a printing system with enhanced speed for all classic 2PP applications. Starting from structure details in the 100-nanometer range to components with an edge length of up to 40 mm or full-surface printed wafers.

nanoONE bio

The only 2PP printer with an integrated incubation system

NanoOne bio allows 3D printing of structures in the presence of living cells for biological applications with unprecedented precision. Cell models mimicking natural tissue topography and sterile fabrication of cell scaffolds herald a new era for biomedical research.

nanoONE 1000

More power creates more possibilities

The NanoOne 1000 has the most powerful femtosecond laser in its class. This makes it the right choice not only for classic 2PP applications but also to produce mesoscale structures and for the printing of exotic resins.

nanoONE green

515 nm green laser allows for broader applications

The NanoOne green's differentiating factor is its green wavelength of 515 nm and laser power of 400 nm. With 30% higher precision compared to a 780 nm laser wavelength and ability to work with a broader range of standard and transparent materials, the NanoOne green supports a variety of new, exciting research and industrial applications.

	nano one 250	nano one 1000	nano one bio	nano one green
Average power	250 mW	1,000 mW	1,000 mW	400 mW
Pulse length	90 fs	90 fs	90 fs	90 fs
Bio unit	Optional	Optional	Included	Optional
Included objectives*	40x NA 1.4 20x NA 0.7 10x NA 0.4	40x NA 1.4 20x NA 0.7 10x NA 0.4 5x NA 0.25	40x NA 1.4 20x NA 0.7 10x NA 0.4 10x NA 0.3 5x NA 0.25	40x NA 1.4 20x NA 0.7 10x NA 0.4

* Further objectives can be added

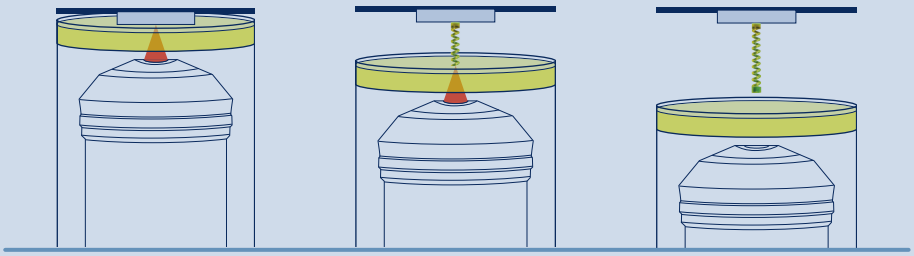
Dip-in-free printing: How it works

2PP is a non-linear process which, due to the high absorption selectivity, only results in resin polymerization in the focal point of the laser beam.

This enables the production of high-precision structural details smaller than the laser wavelength in the sub-micrometer range, directly within the resin volume.

Vat mode

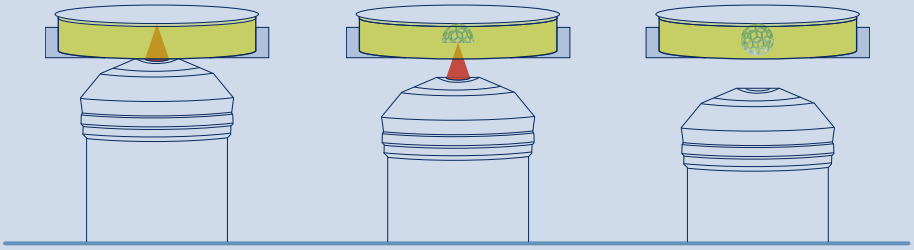
Printing of structures with finest details and a height beyond 40 mm



- Standard substrates up to and just beyond 40 mm edge length
- High level of design and manufacturing freedom
- Vats with cap for resin storage
- Constant focusing power

Top-down mode

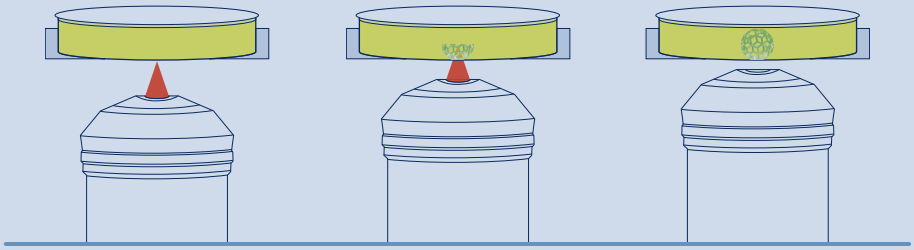
**Printing in highly viscous resins,
with the highest precision**



- Complex freestanding structures
- Manufacturing within microfluidic chips
- Sterile manufacturing possible
- Printing on wafers up to 6-inch

Bottom-up mode

**Print mode for structures
within resins**



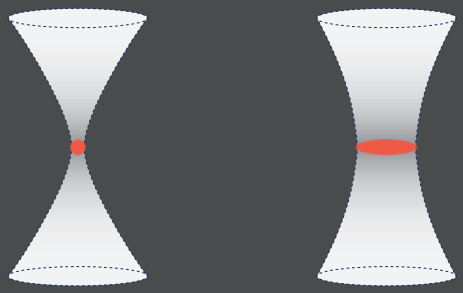
- Suitable for all types of resins including biomaterials
- Glass(-bottom) substrates
- Sterile manufacturing possible

Highest resolution and unbeatable printing times

Each NanoOne model comes standard with several objectives, giving the user a range of choices for their resolution requirements.

Adaptive resolution
Significant throughput increase can be achieved using any objective by taking advantage of our patented **Adaptive Resolution™** technology. The software classifies the geometry in high-resolution and high-speed areas and adapts the laser voxel size accordingly.

UpNano's proprietary outline mode enables high resolution and surface roughness down to <10 nm. The contours of solid printed components are written with the highest possible resolution to exploit the full potential of the respective objective.



High-resolution region
Fine mode: The laser is precisely focused to achieve the highest possible resolution.

High-speed region
Coarse mode: The laser focus is enlarged to increase throughput, while maintaining the part properties.

Overview of standard objectives

	Wavelengh	 40x	 20x	 10x	 5x	 10x
nano one bio	780 nm	✓	✓	✓	✓	✓
nano one 250	780 nm	✓	✓	✓		
nano one 1000	780 nm	✓	✓	✓	✓	
nano one green	515 nm	✓	✓	✓		
Numerical aperture		1.4	0.7	0.4	0.25	0.3
Working distance[1]		0.13 mm	0.35 mm	3.1 mm	12.5mm	10.0 mm
Immersion medium		Oil	Water	Air	Air	Air
Horizontal feature size[2]	780 nm	<220 nm	<420 nm	<740	<1.2 µm	<980 nm
	515 nm	<150 nm	<280 nm	<490 nm	<780 nm	–
Vertical feature size[2]	780 nm	<550 nm	<2.9 µm	<9.2 µm	<23 µm	<16.4 µm
	515 nm	<350 nm	<1.9 µm	<6.1 µm	<15.9 µm	–
Highest resolution XY[3]	780 nm	<150 nm				
	515 nm	<100 nm				
Highest resolution Z[4]	780 nm	<150 nm				
	515 nm	<100 nm				
Field of view diameter[5]		0.5 mm	1 mm	2 mm	4 mm	2 mm
Typical writing speed		150 mm/s	300 mm/s	600 mm/s	1,200 mm/s	600 mm/s
Throughput fine mode	780 nm	0.05 mm^3/h	0.25 mm^3/h	4 mm^3/h	30 mm^3/h	6 mm^3/h
	515 nm	0.025 mm^3/h	0.125 mm^3/h	2 mm^3/h	15 mm^3/h	3 mm^3/h
Throughput coarse mode	780 nm	0.25 mm^3/h	2.25 mm^3/h	40 mm^3/h	300 mm^3/h[6]	60 mm^3/h
	515 nm	0.125 mm^3/h	1.13 mm^3/h	20 mm^3/h	150 mm^3/h	30 mm^3/h

[1] The working distance is the physical distance between the objective and the focal plane. However, the effective optical path length can vary due to refractive index mismatches and the numerical aperture (NA).

[2] Calculated Full Width Half Maximum (FWHM) for printing power twice the threshold, see Zipfel et al "Nonlinear magic" doi:10.1038/nbt899.

[3] Smallest free hanging line.

[4] By submerging voxel in substrate.

[5] Based on a field number of 20.

[6] By adapting parameters, throughput of >450 mm^3/h can be achieved.

Besides the listed standard objectives, which are included with the purchase of a machine, a range of other objectives are available on the platform, such as 100x, 63x, 60x, 4x or other specific objectives. Please ask for details.

Resins for any application

UpNano's high-performance 2-photon resins are engineered and optimized to utilize the full potential of the NanoOne high-resolution printing system. The portfolio includes nine resins, each with special properties for specific applications – from performance printing resins to opto-transparent resins for optical and microfluidic applications to biocompatible formulations.

Standard production

High performance 2-photon resin
Functional parts, fully polymerized after printing, autoclavable, non-cytotoxic*

Fast prototyping 2-photon resin
Ultrafast printing, prototyping resin, allows increased layer spacing

Optically transperent

Ultralow-fluorescent 2-photon resin
Optically highly transparent, ultralow autofluorescence, transmission down to 350 nm, UV post-curing required, non-cytotoxic*

Low-viscosity, low-fluorescent 2-photon resin
Optically transparent, low fluorescence and viscosity, UV post-curing required, for printing microfluidics, channels ≤50 µm, non-cytotoxic*

High-resolution applications

Sol-gel hybrid 2-photon resin
Thin film resin, for spin-coating or drop-casting, 2.5D and micro 3D structures, printing of overhangs, free-floating structures

Refractive index-matched 2-photon resin
Highest resolution printing, used in vat mode, 2.5D and micro 3D structures

Special applications

High-temperature 2-photon resin
Great mechanical stiffness, exceptionally high heat deflection temperature (HDT-B) >300°C, high-temperature applications, non-cytotoxic*

Low-transmissive 2-photon resin
Light blocking for UV-VIS, transparent to NIR and IR, optically black non-transparent appearance, non-cytotoxic*

2-photon silica slurry
Properties of fused silica glass include extremely high thermal and chemical resilience, exceptional mechanical strength, high optical transmission, and inertness, making it a biocompatible material.

* Certified according to EN ISO 10993-5:2009

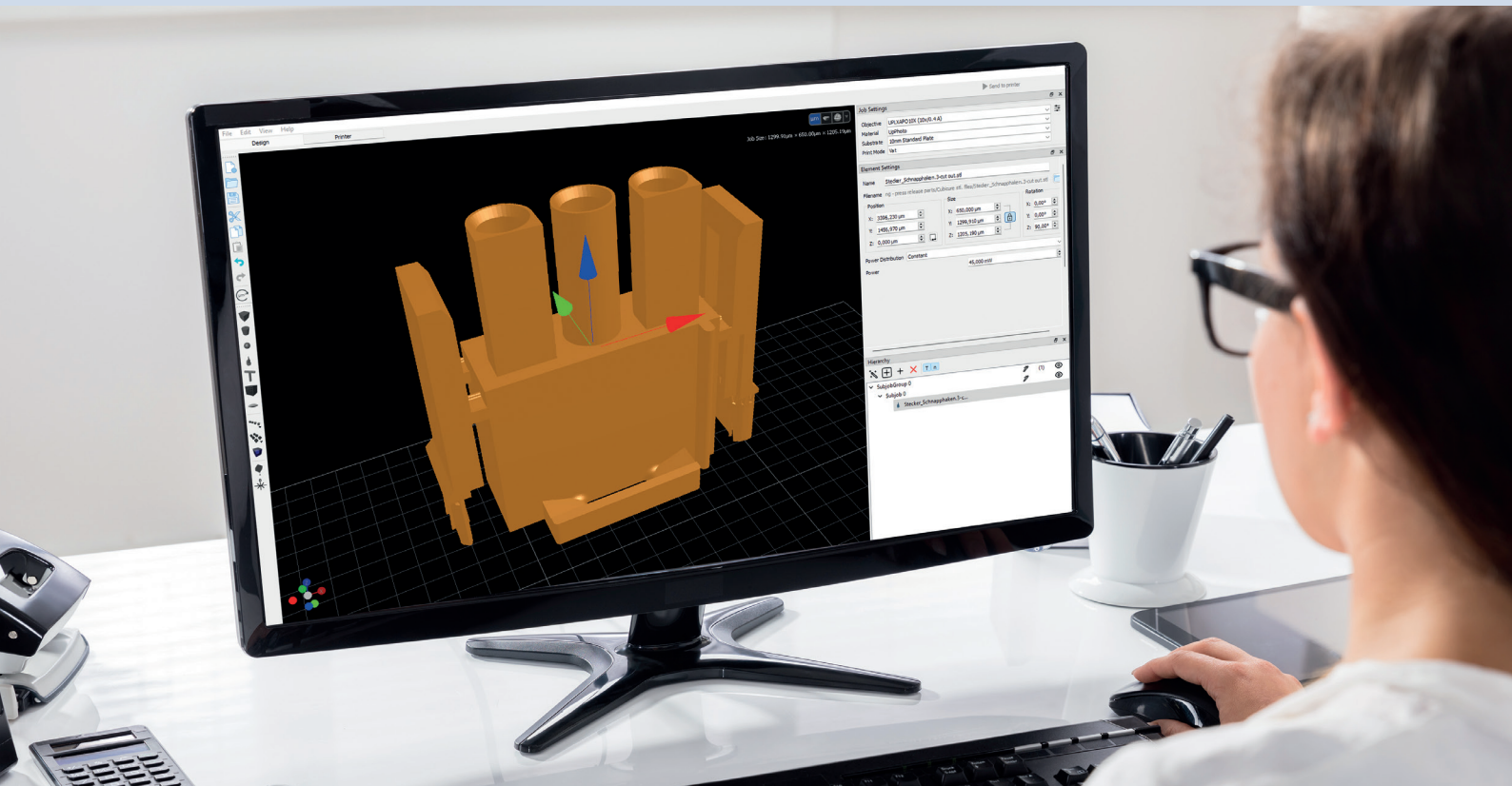
If you **think3D** it is easy to print 3D

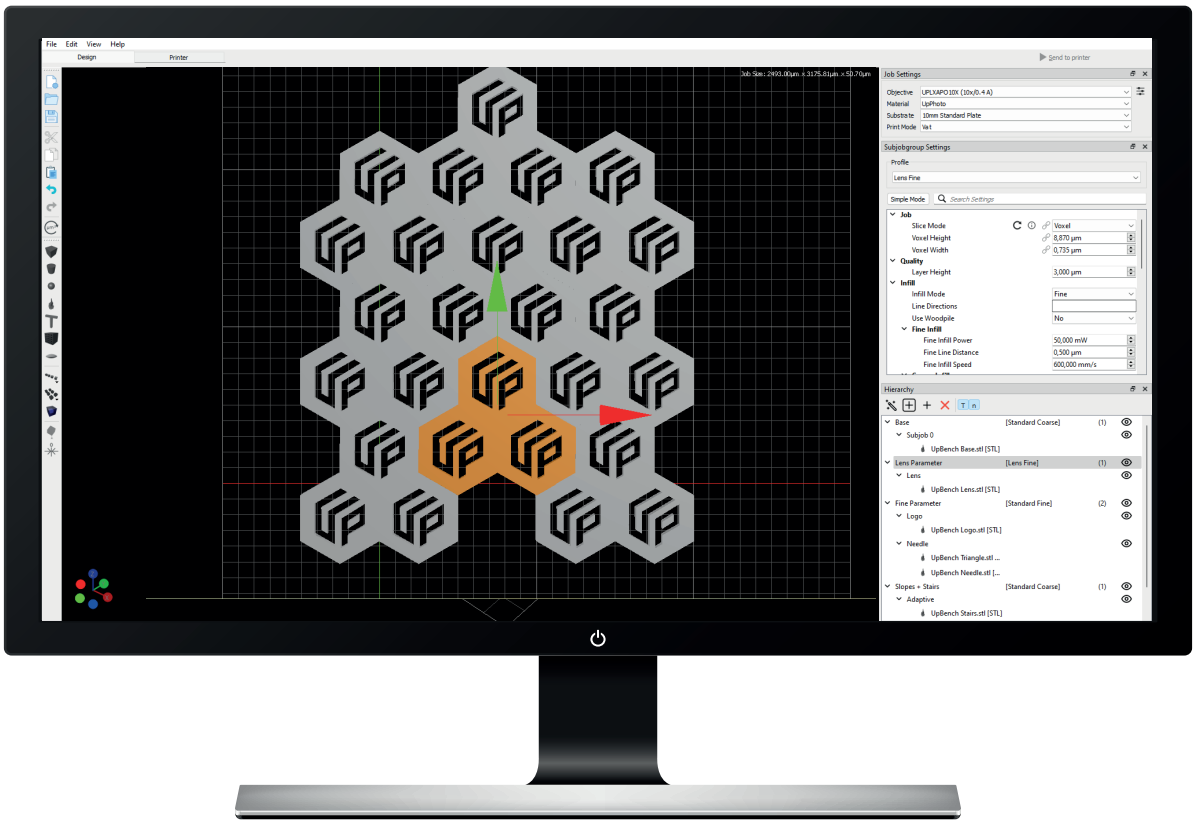
The Think3D™ data preparation software supports the user in a unique, intuitive way. Structures can be imported directly into the software as STL files or geometries can be built up from predefined structural elements.

The Think3D™ software supports the customer throughout the entire printing process in an intuitive and easy way. Everything is accessible in one software interface including the set-up of the print structure and parameters, the start and remote monitoring of the print job and beyond.

Key features

- Save print job files including all parameter settings
- 3D preview of the created print job
- Real-time slicing engine, no waiting for data to be processed
- Adaptive resolution for combined resolution and speed where needed
- Remote monitoring is integrated and automated
- Visualization of field of views and easy customization
- Software accepts STL and G-code
- JobQueue function





Intuitive interface

The user interface design is intuitive and easy to use. The graphical 3D preview provides an overview of the job design, the field of view as well as stitching and slicing position.

Printing profiles

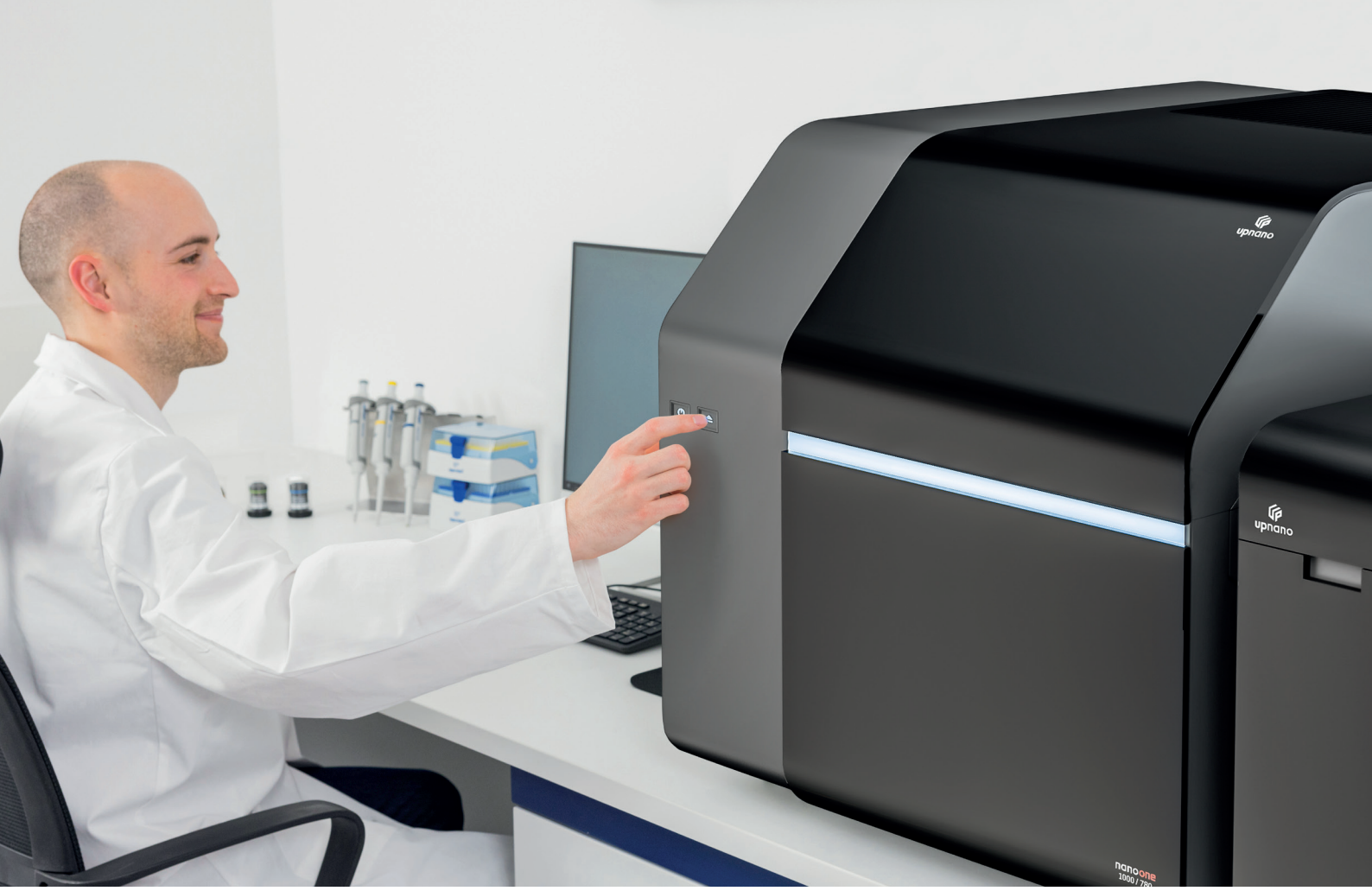
Predefined print profiles, which are optimized for the selected objective and resin, guarantee simplicity of use and fast print results in high quality.

Sub-jobs

By using the sub-jobs function, individual printing parameters can be applied for single parts or groups. Therefore, high-resolution and high-speed regions can be combined into one job.

Well-plate mode

With the well-plate wizard, it is easy to assign a different structure to each well and/or to vary the parameters from one well to another in a standard cell culture plate.



nanoone bio

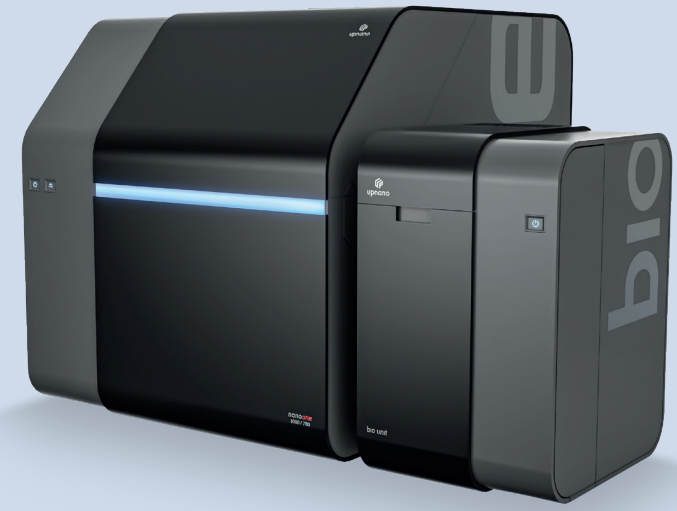
Harnessing the new dimension in 3D bioprinting

The pioneering NanoOne bio combines the possibility of biocompatible applications with the characteristic high precision of the NanoOne platform.

Based on the technology of 2-photon polymerization and equipped with a powerful 1,000 mW femtosecond laser, the system enables applications from nano to centimeter scale.

Fabrication of structures within microfluidic chips or cell culture plates using top-down or bottom-up printing mode are made possible. The process may be performed in the native cell environment and/or under sterile conditions.

The only 2PP printer with a genuine integrated incubation system



The bio unit is the centerpiece of the NanoOne bio and can be used to provide a native, stress-free environment for living cells during the printing process.

The stage-top incubation system boasts a plethora of features allowing adjustments to match the preferential environmental conditions of the respective cell type, and ensures these conditions during the print. Definable parameters include temperature, CO_2 content, and humidity.

Incubation system

- Ambient temperature to 45°C ± 0.05°C
- Actively humified 20–99% ± 0.1%
- CO_2 concentration 0–15%
- Compatable substrates
  - Glass-bottom µ slides
  - Injection-molded microfluidic chips

Additional substrates

- Glass-bottom full-size well plates
- Glass-bottom petri dishes Ø 20–74 mm

Unlimited possibilities

- Cell-containing samples for three-dimensional in-vitro tests
- Filter elements with defined pore sizes and gyroid structures
- Barrier models with defined semi-permeability within microfluidic chips
- Scaffold structures positioned in each individual well of a cell culture plate
- Cell models mimicking natural tissue topography and microenvironments
- Medical devices such as implants or microneedle arrays

Biocompatible printing resins according to EN ISO 10993-5

In addition to a cell-compatible process, the printing resin is a decisive factor. UpNano has a portfolio of five biocompatible resins certified as non-cytotoxic according to EN ISO 10993-5:2009.

Each of these resins, in addition to their biocompatibility, have distinct properties emphasizing the wide range of possible applications.

upphoto upopto upthermo

upblack upflow

Compatible substrates

- Standard glass-bottom well plates in any configuration
- Glass-bottom petri dishes Ø20–74 mm
- Glass-bottom µ slides and µ dishes in different formats
- Microfluidic chips commercially available or custom-made
- UpNano glass substrates and wafers
- Opaque and translucent wafers

BIO INX® – High-quality bioinks and biomaterials

Together with the Belgian company BIO INX®, we have established a material portfolio that is not only cell-compatible but also optimized for the NanoOne platform.

HYDROBIO INX® U200

Gelatin-based hydrogel resin

Cell interactive, gelatin type B-based hydrogel, derived from natural collagen. Unique two-component bioresin enabling printing in the presence of living cells with low autofluoresence. Suitable for light- and laser-scanning microscopy, biodegradable and non-cytotoxic (ISO 10993-5).

DEGRAD INX® U100

Polyester-based, biodegradable resin

Robust, biodegradable thin-film material (2–5 years), solid state cross-linking: suitable for both bottom-up and top-down printing. Extremely high resolution (<500 nm), supports overhangs, for cell seeding, non-cytotoxic (ISO 10993-5).

HYDROTECH INX® U200

Synthetic, technical hydrogel

Bioinert, mechanically robust, soft and flexible hydrogel resin. Orange-red viscous liquid, allowing for VAT mode or in-chip printing. White flexible solid after development in dry state. Opaque when swollen in water. SEM imaging compatible because of its drying and rehydrating properties. Suitable for cell seeding, non-degradable, non cytotoxic (ISO 10993-5).

HYDROTECH INX® U100

Technical thin-film hydrogel

Bioinert, synthetic hydrogel material for bottom-up and top-down printing with high mechanical integrity. No structural deformation in aqueous medium, due to low water absorption capacity. Suitable for cell seeding, non cytotoxic (ISO 10993-5).

"The combined competences of UpNano in developing 3D printing systems and BIO INX® in designing innovative inks for 3D printing gelled well together. Our U-product line of biomaterials for multiphoton lithography features excellent processability and reproducibility. Especially for high-resolution bioapplications, it is important that hardware and printing resin are optimally matched to each other."

Jasper van Hoorick, CEO and co-founder of BIO INX®

BIO INX® – a spin-off company of Ghent University and Vrije Universiteit Brussel – focuses on the commercialization of materials and bioinks for 3D bioprinting or biofabrication. For product development and establishment, the team relies, among other technologies, on a NanoOne bio system. The integrated incubation system is essential and important for their work. HYDROBIO INX U200 is the first hydrogel for use together with living cells and 2-photon polymerization that is also crystal clear for light-microscope use, a very important factor for many researchers.

Many years of research work by the team have already resulted in a remarkable material portfolio. With a diverse range of material properties, the applications become nearly limitless: the bioinks can be applied for various tissue types with applications in regenerative medicine as well as drug and cosmetics screening and bioengineering.

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