MATERIALS OVERVIEW

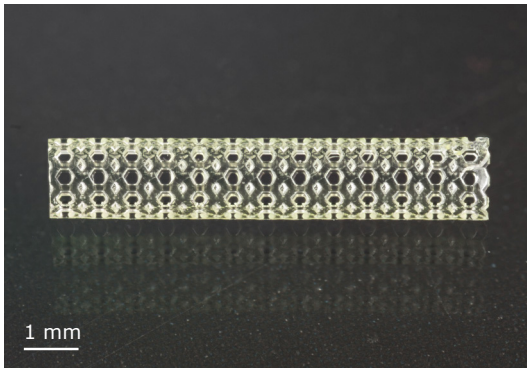
NANOSCRIBE'S IP PHOTORESINS

The 3D printers from Nanoscribe are designed as open systems for a broad range of materials. The printable materials may have different optical, mechanical, electrical, chemical and biological properties, as needed, for example, in micro-optics, photonics or biomedical applications.

Nanoscribe provides a product line of negative-tone resins, called IP photoresins that are optimized for two-photon polymerization (2PP). The printer software offers advanced recipes for different IP resins and applications, speeding up the design iteration cycles for scientific use cases and industrial applications in the nano-, micro- and mesoscale.

IP resins are established standard materials for high-resolution 3D printing. High resolution and shape accuracy as well as easy handling are key features of these (meth-)acrylate-based resins. The IP resins are applied by drop on a substrate whereby minimum quantities of the resins are needed for printing. The resulting polymeric 3D printed parts are thermosets.

The resins provide best performance for a broad range of applications, *e.g.,* from micro-optics for rapid prototyping and small series production to biomedical devices such as cell scaffolds and micro-implants.



Porous tube of 8 mm length 3D printed in IP-Q and in 1:10 h

KEY FEATURES

- Specifically designed for 2PP-based 3D printing
- Minimum feature sizes of typ. 160 nm
- High-speed 3D microprinting
- Very good adhesion to various substrates
- Optimized mechanical stability and excellent shape accuracy
- Straightforward handling and easy processing
- No spin-coating required

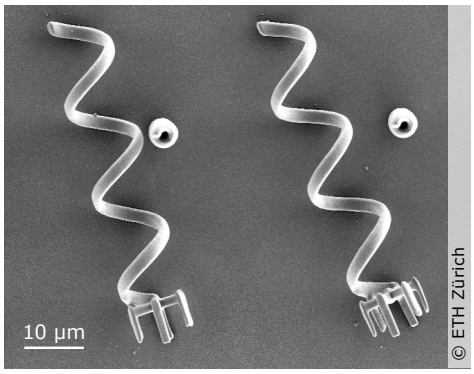
OVERVIEW

Resin	Advantages	State	Scan speed	Sample size	Resolution	Possible applications
IP-Q	High-speed fabrication up to macroscale structures with volumes of tens of mm³. Designed for Dip-in Laser Lithography (DiLL).	Liquid	High	Micro/ Meso/ Macro	Standard	Biomedical engineering, mechanical components, micro rapid prototyping.
IP-S	Smooth surfaces for micro- and mesoscale fabrication with optical-quality surface roughness and shape accuracy. Designed for Dip-in Laser Lithography (DiLL).	Liquid	High	Micro/ Meso	Medium	Mechanical metamaterials, micro-optics, integrated photonics, microfluidics, cell scaffolds.
IP-Dip	Submicron features and high aspect ratios. Designed for Dip-in Laser Lithography (DiLL).	Liquid	Medium	Nano/ Micro	High	Photonic metamaterials, diffractive optical elements, microrobots.
IP-G 780	Complex 3D designs, e.g., overhanging elements. Submicron features and low shrinkage. Designed for oil immersion configuration.	Sol-gel	Medium	Nano/ Micro	High	Overhanging elements in biomimetics, photonics, microrobots.
IP-L 780	Submicron features and low shrinkage. Designed for oil immersion configuration. Compatible with DiLL.	Liquid	Medium	Nano/ Micro	High	Plasmonics, photonic and biomimetic surfaces.

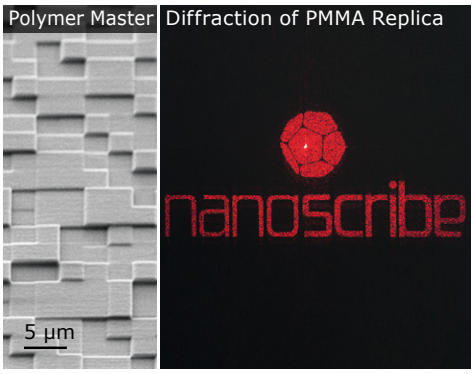
POST-PROCESSING & REPLICATION

Nanoscribe systems are ideal for printing polymer objects directly from CAD models. The 3D printed structures are used directly or serve as templates for post-print processes to meet materials other than polymers. Casting, coating, plating and pyrolysis techniques are used to modify the 3D printed structures. This way, a wide range of materials becomes accessible, such as ceramics, metals, silicon and carbon. The printed parts with replicable topographies serve as polymer masters for serial production. Some post-print processes are listed here:

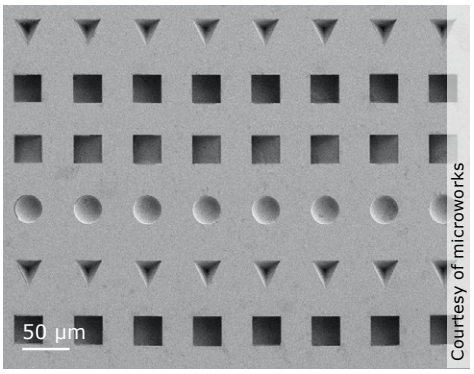
- Atomic layer deposition (ALD)
- Chemical vapor deposition (CVD)
- Physical vapor deposition (PVD)
- Electroless plating
- Galvanization
- Casting in PDMS
- Nanoimprint lithography
- Hot embossing
- Injection molding



Magnetic helical micromachines. 3D polymer structure made of a negative-tone resin (e.g., IP-L or SU-8) coated with ferromagnetic nickel.



3D printed DOE polymer master in IP-Dip (left) for direct hot embossing into PMMA (right).



Nickel shim fabricated from a 3D printed polymer master of micro-optics made of IP-S.

MORE 3D MICROPRINTING MATERIALS

Beyond IP resins, other commercial UV-curable resists used in the microelectronics industry are also suitable for Nanoscribe's 3D printers. The range of materials extends to hydrogels and nanoparticle composite resins as well as custom-made materials.

- Commercial photoresists from other vendors
  - SU-8 – negative-tone, epoxy-based resist
  - AZ® photoresists – positive-tone resists
  - ORMOCER® polymers – inorganic-organic hybrid materials
- Custom-made materials
  - Hydrogels – *e.g.,* degradable resins
  - Composite materials
  - Liquid-crystal elastomers

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