

3D Printing on the Micrometer Scale

Nanoscribe presents a novel high-speed 3D printer

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Eggenstein-Leopoldshafen The Photonic Professional GT (see image 1) is the world's fastest commercially available 3D printer for micro- and nanostructures. It is introduced at the international trade fair Photonics West in San Francisco (USA) this week. Nanoscribe's next-generation 3D printer enables very fast and highest-resolution manufacturing of three-dimensional micro-objects, which are often smaller than the diameter of a human hair. The printing speed was increased hundredfold by employing a novel laser lithography method, enabling completely new applications.



Image 1: High-speed 3D printing on the micrometer scale: The novel Photonic Professional GT of Nanoscribe

Nanoscribe was founded in 2007 as the first spin-off of the Karlsruhe Institute of Technology (KIT) and has since established itself as the world market and technology leader in the area of 3D laser lithography.

Speed: Minutes Turn into Seconds

The significant increase of the printing speed was achieved by implementing a galvo mirror system similar to those used in laser show devices or scanning units of CD and DVD drives. Reflecting a laser beam off the rotating galvo mirrors facilitates rapid and precise lateral laser focus positioning.

Nanoscribe's CEO Martin Hermatschweiler explains: "We are revolutionizing 3D printing on the micrometer scale: The demands for precision and speed at the same time are met by industrially established galvo scanners - a quantum leap in nanofabrication. Our product benefits from more than one decade of experience in photonics, the key technology of the 21st century. Our 3D printers were already unrivaled in precision and resolution, user-friendliness, and compactness. Now they also stand out due to their enormous speed. Just for comparison: Using the novel system, the time required for printing a miniature spacecraft (see image 2) was reduced from hours to minutes without any loss in structure quality! Our customers will profit tremendously from the extended application range of our product."

The GT version of the Photonic Professional will be equipped with a new modular controller, which facilitates the introduction of optional hardware extensions in the future. Various new features have also been integrated into the software. The electronics cabinet has been redesigned for a more elegant and modern appearance.

Mechanism: Two-photon Polymerization

The direct laser writing technique underlying the 3D printing method is based on two-photon polymerization. Just as paper ignites when exposed to sunlight focused through a magnifying glass, ultra-short laser pulses polymerize photosensitive materials in the laser focus. This crosslinking of polymer chains renders the exposed volume insoluble relative to its unexposed environment. After washing away the unexposed material in a developer bath, the exposed regions remain as self-supporting 3D micro- and nanostructures.

Breaking down Technical Barriers

The galvo technology is an essential building block for high-speed, large-area printing of three-dimensional micro- and nanostructures. At the highest resolution, the scanning field is physically limited to a diameter of a few 100 μm due to the optical properties of the focusing objective. Just as floor tiles must be joined precisely, the respective scanning fields must be connected seamlessly and accurately. By using a patented autofocus technique and high-precision positioning stages, areas can be extended almost arbitrarily by a so-called stitching process. As an example, square-centimeter-sized micro-optical arrays have been manufactured with this approach.

The limit on the overall structure height that is imposed by the limited working distance of the microscope objective has been broken by means of the patented Dip-in Laser Lithography (DiLL) method. In that way, highest-quality structures with heights above 100 μm can be achieved (see image 3). Chief Science Officer Dr. Michael Thiel, in charge of the development of photosensitive materials, explains: "Our IP-Dip resist has been specifically developed for DiLL in order to guarantee high-quality results. Structures can be designed in CAD software and the resulting 3D models are then easily fabricated with DiLL. Our IP-Dip resists for DiLL guarantee the highest resolution and homogeneity. In spite of these highly technical issues, the complexity remains of no concern to the user. We offer a complete process chain to our customers who highly appreciate the ease and reliability of the printing process while going far beyond previous 3D printing standards."

Precision Tools for a Wide Range of Applications

Nanoscribe's laser lithography systems are being used successfully by renowned scientists throughout the world to solve tomorrow's challenges. They are the drivers of innovation for numerous key technologies. Photonics, for example, intends to replace conventional electronics by higher-performance optical circuits. Polymeric optical waveguides realized with Nanoscribe's 3D printing technology already demonstrate record-breaking data transmission rates of more than 5 Tbit/s. In Life Sciences, three-dimensional tailored matrices are already being fabricated for tissue engineering and cell growth studies. Material researchers on the other hand develop functional materials with improved performance properties, such as reduction of weight by ultra-light complex structures that save our resources. Since complexity doesn't add to the costs in a 3D printing process, everything is possible!

Nanoscribe CEO Martin Hermatschweiler is convinced that the new *GT* generation will attract enormous interest.

For further information and examples of use, please refer to www.nanoscribe.de.

Company Profile



Nanoscribe GmbH, the first spin-off of Karlsruhe Institute of Technology (KIT) introduced the 3D laser lithography system Photonic Professional in early 2008. Over the last five years, the company has established itself as market and technology leader in the area of 3D laser lithography. The multitude of systems sold to leading research institutes and universities across the world demonstrates the triumph of this innovative technology. In September 2008, Carl Zeiss AG acquired approximately 40% of Nanoscribe's shares.

The Photonic Professional *GT* is a 3D micro- and nanostructure printer that is second to none on the world market. The portfolio of the company located on Campus North of the Karlsruhe Institute of Technology (KIT) additionally comprises in-house developed resists tailored to the different needs of customers. The portfolio is completed by consultation on reproducing these three-dimensional polymer structures in metals or semiconductors.

The particular significance of this trend-setting technology as well as the company's innovative strength and development potential are reflected by more than 60 scientific publications in high-ranked scientific journals and articles in various technical magazines.

Please refer to www.nanoscribe.de/en/publications-press/press-releases for free download of our press material. Should you have any questions, please contact Mrs. Anke Werner: E-Mail: werner@nanoscribe.de or Phone + 49(0)721/ 60 82 88 49.

Appendix: Photos

All images: © Nanoscribe

Image 1: Nanoscribe_PhotonicProfessional_GT
The world's fastest commercially available 3D printer for micro- and nanostructures.



Image 2: Nanoscribe_Spacecraft
Miniature-spacecraft printed with a Photonic Professional GT system in less than one minute.

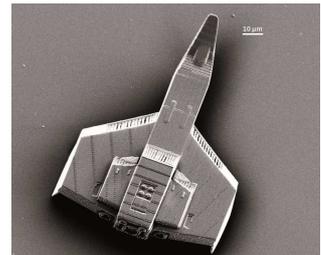


Image 3: Nanoscribe_EmpireStateBuilding
Empire State Building printed with a Photonic Professional GT system by means of the DiLL-Method.

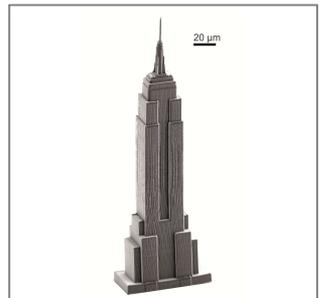


Image 4: Nanoscribe_Hair
Human hair with Nanoscribe lettering.



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