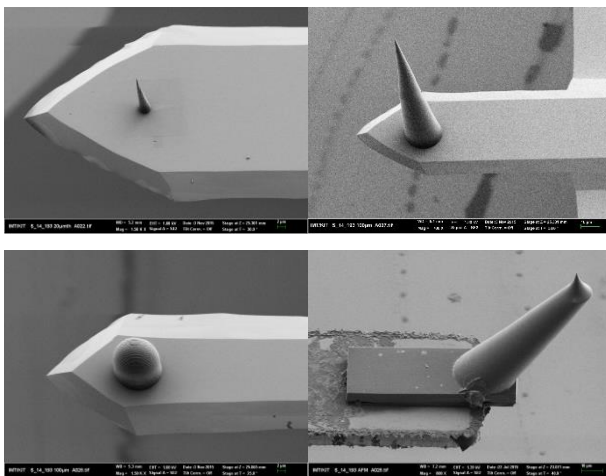


Tailored Probes for Atomic Force Microscopes

3D Laser Lithography Enhances Microscope for Studying Nanostructures in Biology and Engineering/ Publication in Applied Physics Letters



Optimally adapted probes for atomic force microscopes can now be produced by 3D nanoprinting at KIT. Photos: KIT

Atomic force microscopes make the nanostructure of surfaces visible. Their probes scan the investigation material with finest measurement needles. KIT has now succeeded in adapting these needles to the application. For any measurement task, e.g. for various biological samples, a suitable measurement needle can be produced. For production, 3D laser lithography, i.e. a 3D printer of structures in the nanometer size, is applied. This success has made it to the title page of the Applied Physics Letters journal. DOI: 10.1063/1.4960386

Atomic force microscopes are used to analyze surfaces down to the atomic level. The standard probes that have been applied for this purpose so far, however, are not suited for every use. Some examination objects require a special shape or a very long probe to scan deep depressions of the material. KIT researchers have now succeeded in producing probes that are optimally adapted to special requirements.

“Biological surfaces, such as the petals of tulips or roses, frequently have very deep structures with high hills,” says Hendrik Hölscher, Head of the Scanning Probe Technologies Group of KIT’s Institute of

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Microstructure Technology. Commercially available probes typically are 15 micrometers, i.e. 15 thousandths of a millimeter, high, pyramid-shaped, and relatively wide, the physicist points out. Probes with other shapes are offered, but have to be produced manually, which makes them very expensive.

The KIT researchers have now succeeded in producing by means of 3D laser lithography tailored probes of any shape with a radius of 25 nanometers only, corresponding to 25 millionths of a millimeter. This process can be used to design and print in three dimensions any shape desired and has been known in the macroscopic area for some time already. On the nanoscale, this approach is highly complex. To obtain the three-dimensional structures desired, the researchers use the 3D lithography process developed by KIT and commercialized by Nanoscribe, a spinoff of KIT. This method is based on two-photon polymerization: Strongly focused laser pulses are applied to harden light-sensitive materials after the desired structures have been produced. The hardened structures are then separated from the surrounding, non-exposed material. "In this way, the perfect probe can be produced for any sample to be studied," Hölscher explains.

Use of this process for enhancing atomic force microscopy is reported by the researchers in the Applied Physics Letters journal under the heading "Tailored probes for atomic force microscopy fabricated by two-photon polymerization". The probes that can be produced in any shape can be placed on conventional, commercially available measurement needles and are hardly subject to wear. They are perfectly suited for studying biological samples, but also technical and optical components in the range of nanometers.

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