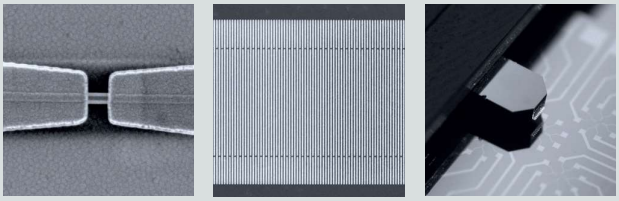
HEIDELBERG INSTRUMENTS

# NanoFrazor

## THE VERSATILE AND MODULAR NANOFABRICATION TOOL

heidelberg-instruments.com

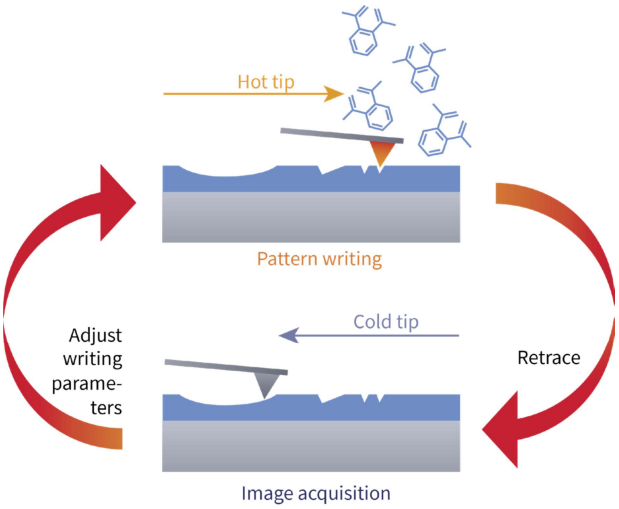
# NanoFrazor

## THE VERSATILE AND MODULAR NANOLITHOGRAPHY TOOL

The NanoFrazor takes nanofabrication to the next level. Building on decades of research and development, the NanoFrazor brings thermal scanning probe lithography (t-SPL) into your laboratory. Its unique capabilities continue to enable many nanotechnology devices and discoveries.

NanoFrazor lithography systems are based on thermal scanning probe lithography. Core of the NanoFrazor technology is an ultrasharp heatable probe tip, which is used for writing and simultaneous inspection of complex nanostructures. The in-situ inspection data are used in a closed feedback loop to adjust patterning parameters for optimal writing. This approach ensures that the desired depth profiles are created in the resist material, including grayscale patterns with unprecedented accuracy.

The heated tip creates high-resolution nanostructures by local sublimation of resists, allowing for a large variety of designs. Standard pattern transfer methods like lift-off or etching can be applied subsequently. The NanoFrazor Recipe Book, which includes recommended process flows and material data, is available to users for direct integration of thermal scanning probe lithography into device fabrication.




Patented “Closed-Loop Lithography” ensures high patterning accuracy.

### MODULARITY

The NanoFrazor is built on a new modular platform that can be configured to best fit each application and laboratory environment. Patterning modes, housing options, and software modules can be combined to give the optimal combination of capabilities, footprint, and flexibility. Upgrades and additional modules can be installed as required, allowing the NanoFrazor to grow with advancing research ideas and requirements.


From left to right: The NanoFrazor as a tabletop version, the standalone version, and in conjunction with a glovebox

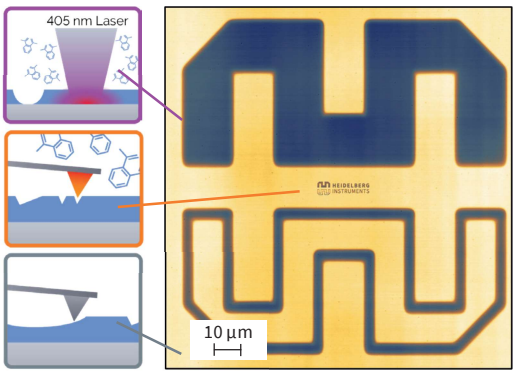
### HYBRID MIX & MATCH DIRECT WRITE LITHOGRAPHY

The NanoFrazor can be equipped with a direct laser sublimation (DLS) module for increased write speed at micrometer resolution. The hybrid mix & match lithography approach, combining t-SPL and DLS, makes the NanoFrazor an excellent tool for complete device fabrication.

**Direct laser sublimation (DLS)**
Fast direct resist sublimation for large-area patterning, e.g. contact wires and pads.

**Thermal scanning probe lithography (t-SPL)**
High precision and high resolution for the critical parts of the nanodevice.

**Metrology, inspection, and alignment**
In-situ high-speed imaging with the same tip before, during or after patterning. Immediate validation of the pattern, as the thermal resist is removed directly, and a topography image is produced in-situ during the lithography session.




Heidelberg Instruments micro- and nano-logos written 30 nm deep into PPA resist and imaged by NanoFrazor

# NanoFrazor

## SYSTEM SPECIFICATIONS

| | Thermal probe lithography | | Direct laser sublimation |
|---|---|---|---|
| | Single tip | Decapede | |
| **Patterning performance** | | | |
| Minimum structure size [nm] | 15 | 15 | 600 |
| Minimum lines and spaces [half pitch, nm] | 25 | 25 | 1000 |
| Grayscale / 3D-resolution (step size in PPA) [nm] | 2 | | |
| Maximum writing field size [X µm x Y µm] | 60 x 60 | 60 x 60 | 60 x 60 |
| Field stitching accuracy (markerless, using in-situ imaging) [nm] | 25 | 25 | 600 |
| Overlay accuracy (markerless, using in-situ imaging) [nm] | 25 | 25 | 600 |
| Write speed (scan speed) [mm/s] | 1 | 1 | 5 |
| Write speed (50 nm pixel) [µm²/min] | 1000 | 10 000 | 100 000 |
| **Topography imaging performance** | | | |
| Lateral imaging resolution (feature size) [nm] | 10 | | - |
| Vertical resolution (topography sensitivity) [nm] | <0.5 | | - |
| Imaging speed (@ 50 nm resolution) [µm²/min] | 1000 | 10 000 | - |

| | | |
|---|---|---|
| **Base system features** | | |
| Substrate sizes | 1 x 1 mm² to 100 x 100 mm² (150 x 150 mm² possible with limitations)<br>Thickness: up to 10 mm | |
| Optical microscope | 0.6 µm digital resolution, 2 µm diffraction limit, 1.0 mm x 1.0 mm field of view, autofocus | |
| Magnetic cantilever holder | Fast (< 1 min) and accurate tip exchange | |
| Vibration isolation | Active vibration isolation stage | |
| **Optional system features / modularity** | | |
| Direct laser sublimation | Laser source and optics: 405 nm wavelength CW fiber laser, 300 mW, 1.2 µm minimum focal spot size<br>Laser autofocus: Using the distance sensor of the NanoFrazor cantilever | |
| Decapede | Parallel writing with 10 tips | |
| Standalone housing | Three-layer acoustic isolation, superior vibration isolation \| PC-controlled temperature and humidity monitoring, gas-flow regulation \| (Dimension 185 cm x 78 cm x 128 cm / weight 650 kg) | |
| Full glovebox integration | Integration in glovebox available for nanolithography in a controlled environment | |
| **NanoFrazor cantilever features (both Single Tip and Decapede)** | | |
| Integrated components | Tip heater, topography sensor, electrostatic actuation | |
| Tip geometry | Conical tip with < 10 nm radius and 750 nm length | |
| Tip heater temperature range | 25 °C – 1100 °C (< 1 K setpoint resolution) | |
| **Base system dimensions & installation requirements** | | |
| Height × width × depth | Table-top unit: 44 cm x 40 cm x 45 cm | Controller: 84 cm x 60 cm x 56 cm |
| Weight | ~50 kg | ~80 kg |
| Power input | | 1 x 110 or 230 V AC, 10 A |
| **Software features** | | |
| GDS and bitmap import, 256 grayscale levels, topography image analysis and drawing for overlay, mix & match between tip and laser writing, fully automated calibration routines, Python scripting | | |

**Please note:** Specifications depend on individual process conditions and may vary according to equipment configuration. Write speed depends on exposure area. Design and specifications are subject to change without prior notice.

HEIDELBERG INSTRUMENTS
The power of direct writing

Visit product website for more information

To contact your local representative, please consult our website *heidelberg-instruments.com*

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