Electron Beam Technology

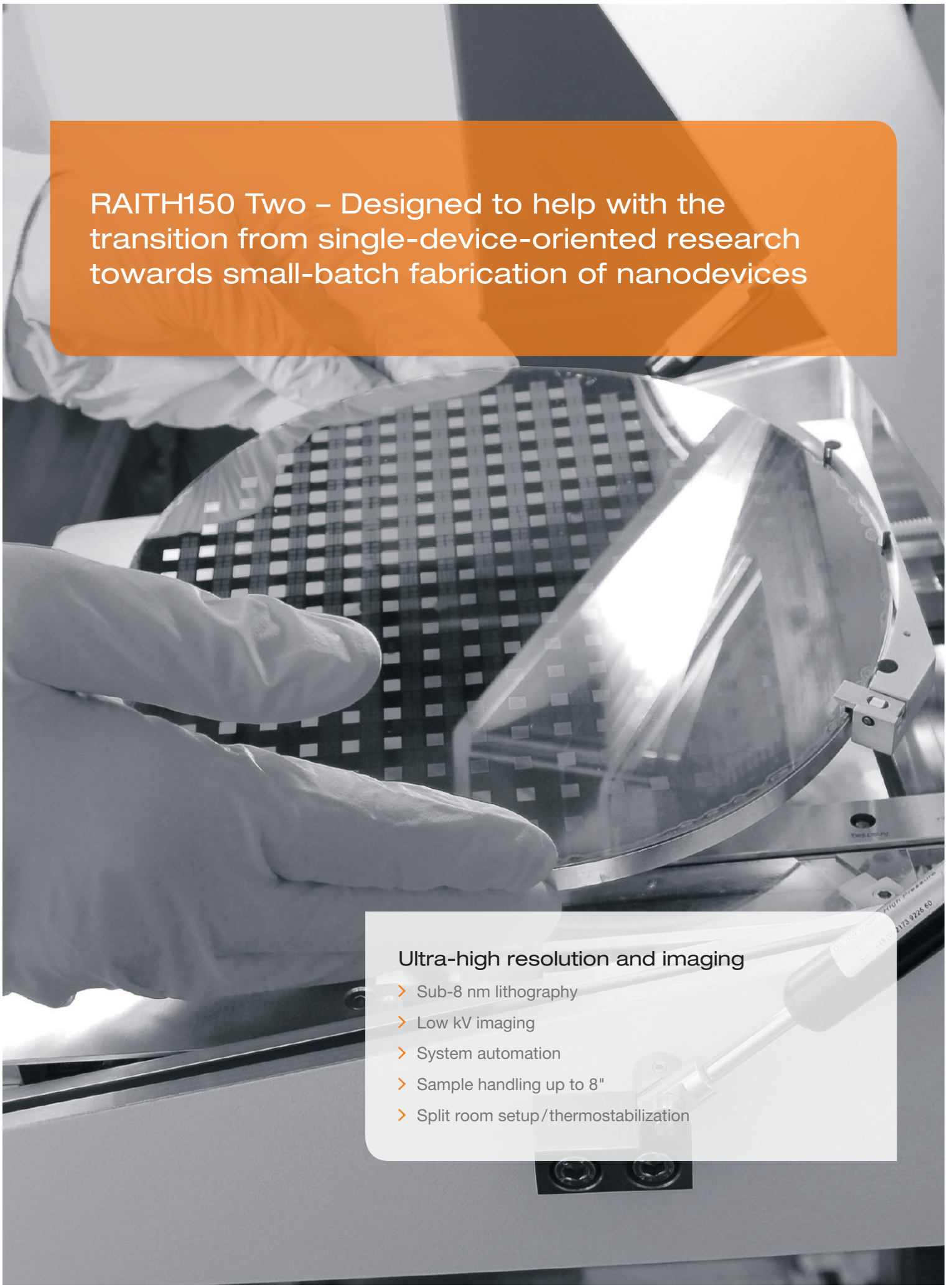
RAITH150 Two

Bridge your technology needs

Ultra High Resolution Electron Beam Lithography and Imaging

DEDICATED ELECTRON BEAM LITHOGRAPHY

RAITH
NANOFABRICATION



RAITH150 Two – Designed to help with the transition from single-device-oriented research towards small-batch fabrication of nanodevices

Ultra-high resolution and imaging

- Sub-8 nm lithography
- Low kV imaging
- System automation
- Sample handling up to 8"
- Split room setup / thermostabilization

RAITH150 Two – The ultra-high resolution direct write tool

Precision and environmental tolerance

Since its introduction, the RAITH150 Two has established itself as a bestseller among universal high resolution Electron Beam Lithography systems. It is used in research and nanotechnology centers worldwide and has proved its robustness in 24/7 use.

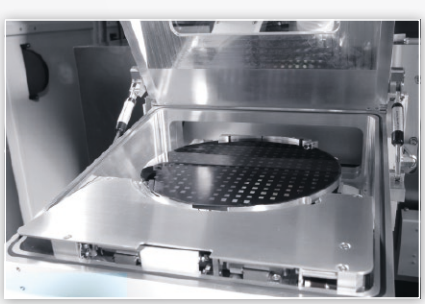
The RAITH150 Two exposes structures far below 8 nm and works with sample sizes from a few mm to 8-inch wafers.

The system stability required for demanding exposures even in difficult environments is made possible by a thermally stabilized and environmentally tolerant shield.

The RAITH150 Two is designed to specifically address changing requirements, i. e. the delivery of reliable, integrated devices using reproducible, professional-quality nanofabrication.

Extensive automation

Nanosized objects themselves may require varying fabrication strategies within a single larger device in order to deliver the latest application results required from different scientific disciplines. RAITH150 Two allows for efficient handling of different requirements through the extensive automation offered by the system.



Fully automated 8 inch loadlock

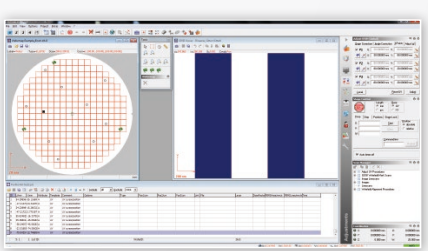
Repeatable performance

With its environmental enclosure and the possibility for a split room setup, the RAITH150 Two delivers high level repeatable quality, irrespective of environmental influences. Hence, the operating environment no longer alters the performance of the system and repeatable automation becomes possible.

Example for split room setup

Speed and ultra high resolution

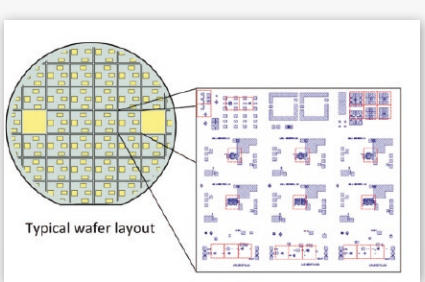
The RAITH150 Two's many unique features enable results to be achieved in shorter timeframes and ultra high resolution structures (far below 8 nm), as are often mandatory components in today's devices.



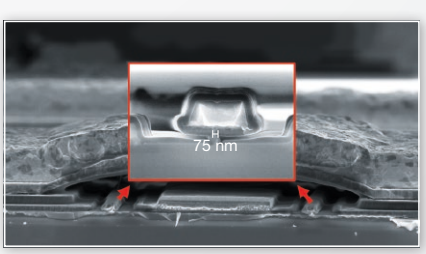
Raith NANOSUITE – convenient and straightforward exposure setup

Extended functionality

The powerful RAITH150 Two supports sub 8 nm lithography as well as multilayer registration and high resolution inspection, and can also handle large samples (wafers up to 8").



Chip layout with Writing Fields (WFs) positioned according to gate positions



Two T-gates (viewed in cross-section) are located under electroplated airbridge

Extensive Automation

Handling of different requirements

Efficient handling of different requirements – from routine patterning services to multi-project wafers with multiple layouts, writing layers, and complex writing requirements – requires professional grade automation.

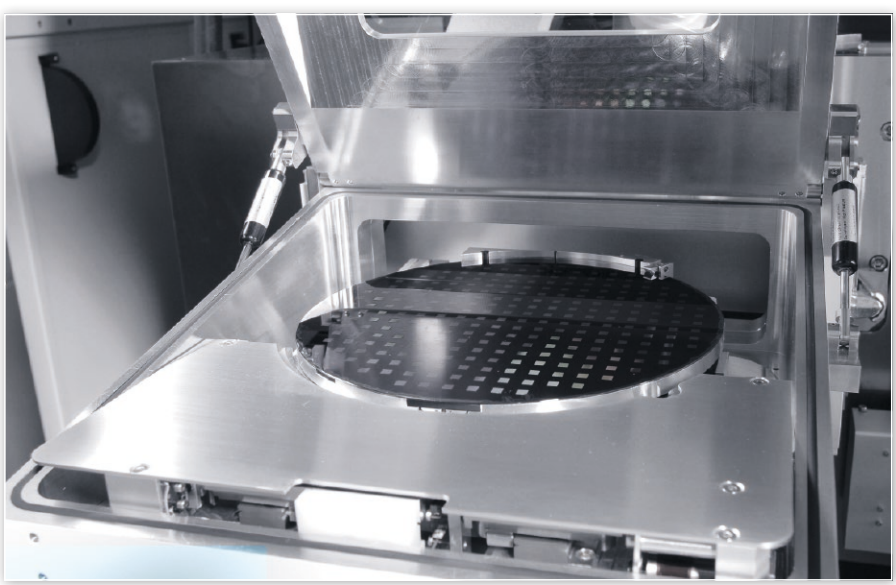
Optimization of sample turnaround

During an exposure run, fundamental exposure parameters such as column settings for beam current, write field size, and voltage or pattern generator settings including step size, dwell time, and exposed layer, can be varied.

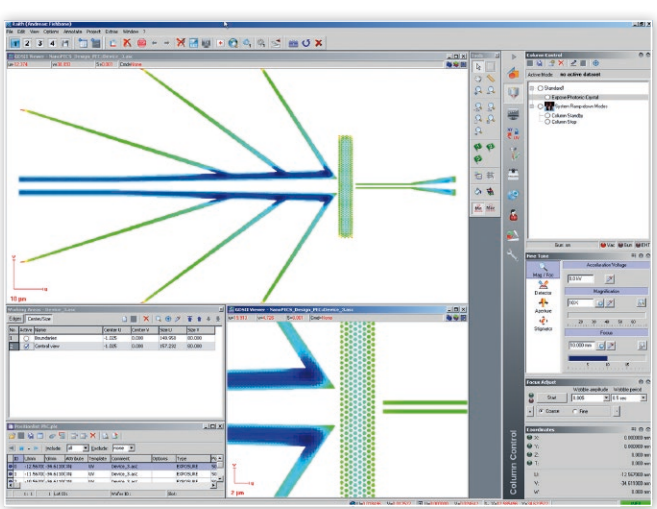
This can be used to switch between ultimate resolution and shortest exposure time to optimize sample turnaround.

Guidance through exposure tasks

A wafer exposure wizard guides operators through the different exposure tasks to be executed. Each step can naturally be executed manually and on single chips if proof of concept studies are required. In addition, automated metrology and process control tasks can be executed to verify process steps as they are developed.



Automated sample transfer



Integrated NANOSUITE for Pattern Editing and Proximity Correction

Repeatable Performance

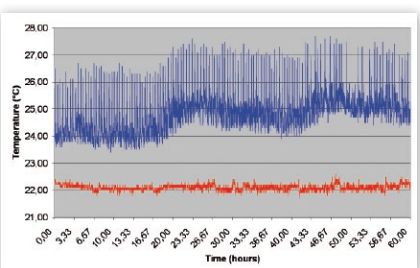
The ultimate performance of a nanofabrication tool is at some point defined by its operating environment.

Tolerant to environmental influences

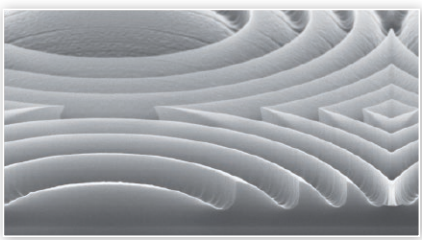
Vibrations, EM fields, temperature fluctuations, acoustic disturbances, and other events can all affect the delivered result, irrespective of the ultimate achievable performance. These potential disturbances become more problematic when applied over the periods required for extended high resolution exposures. The RAITH150 Two environmental enclosure ensures that best performance becomes normal long-term performance and enables further system improvements to become available to users rather than being masked by environmental factors.

Robust design

Underneath the shielding all electron-optical components, power supplies, and electronics are kept at a constant temperature. Based on a proven RAITH150 concept, the RAITH150 Two stage and chamber mechanics were further optimized, leading to higher specification stitching, overlay and beam/ sample stability, even under less favorable site conditions.



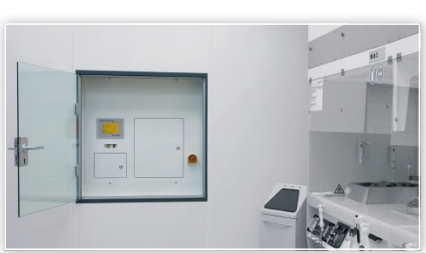
No impact on system demonstrated by artificial fluctuations of room temperature



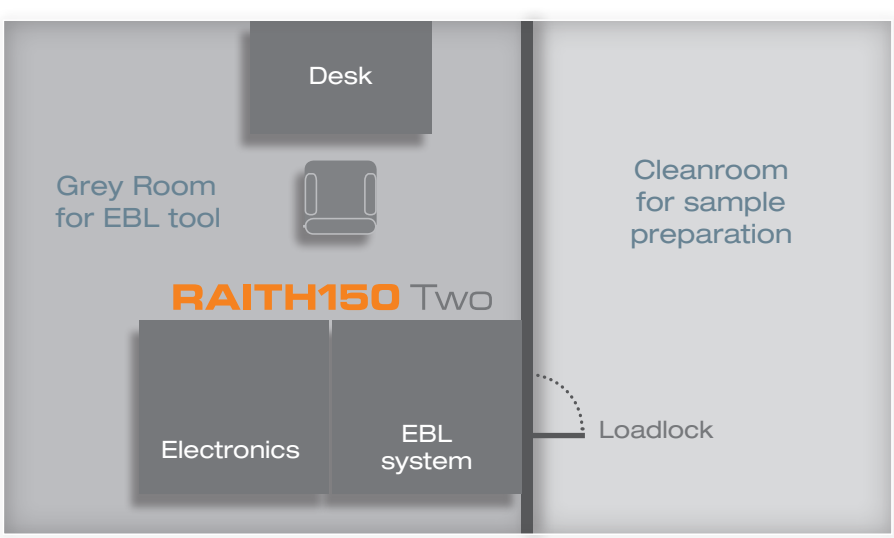
Fresnel lense array in 5 µm thick resist

Split room setup

The RAITH150 Two can be installed outside the clean room, where samples can be prepared and processed before being loaded into the RAITH150 Two via a transfer window.



Sample loading via transfer window

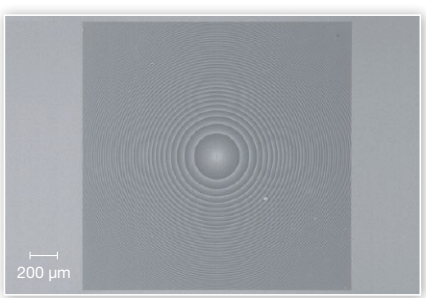


Fast Operation

The RAITH150 Two is the perfect choice to smooth the transition from single-device-oriented research towards small-batch fabrication of nanodevices.

Speed

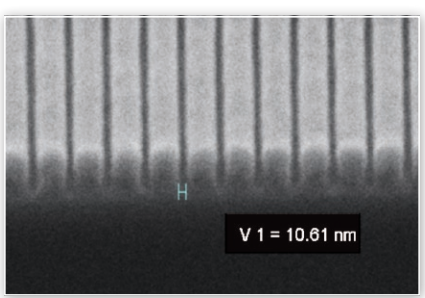
The RAITH150 Two features faster loading cycles, shorter stage settling times, faster writing speed, larger field sizes, AND provides significantly higher specifications for stitching and overlay compared to its predecessor model, the RAITH150.



2 x 2 mm² / 6 min.

Technology

The RAITH150 Two is supplied with a 20-MHz digital Pattern Generator, making it possible to use highly sensitive resists and larger beam currents. The crossover-free column of the RAITH150 Two guarantees that these currents can be achieved without losing resolution. For example, a beam current of approx. 3 nA can be achieved in 4 nm beam diameter resulting in beam current density of over 20,000 A/cm² – important for reliable fiducial reading and easy spot formation even at the smallest beam size.

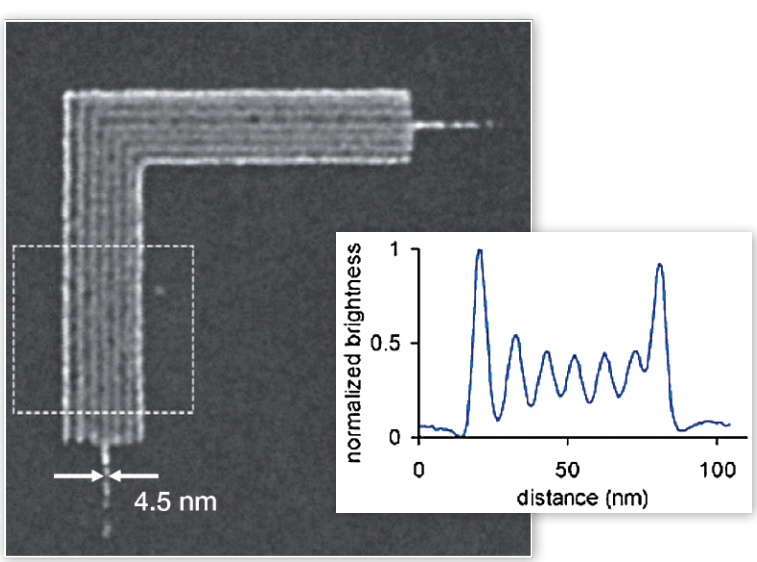


UHR crossection: 11 nm lines in PMMA

60 nm pitch grating in PMMA

Ultra high resolution

As lower energy consumption becomes a challenge in the age of mobile devices, higher-speed electronics and lower heat production for microdevices with ultra-high-resolution structures are playing a very important role within R&D. The RAITH150 Two has demonstrated this capability for years and was the first system to deliver repeatable < 5nm structures as early as 2009 (cooperation with MIT).



9 nm pitch; 10 kV voltage; 10 nm resist

Extended Functionality

The RAITH150 Two supports all current and emerging nanolithography applications. It now incorporates innovative and unique exposure schemes for fabricating nanooptical devices or nanoimprint templates.

Column technology

The powerful electron column offers a unique high resolution inspection and metrology mode.

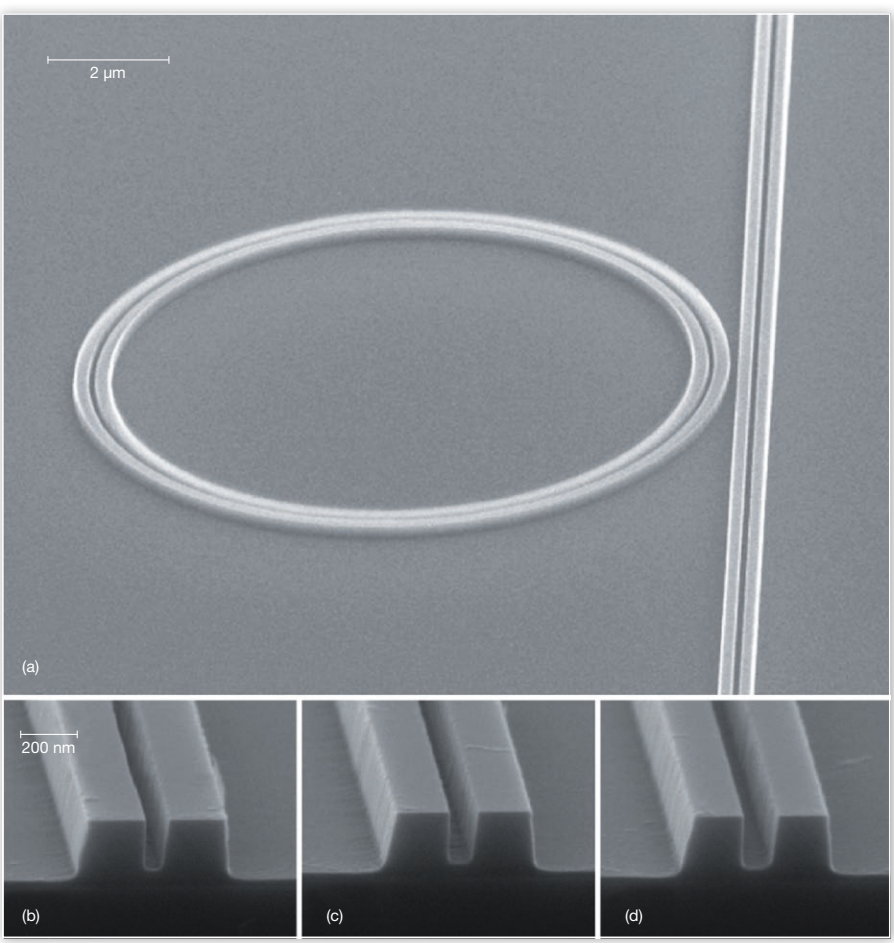
- High current density
- Smallest spot size < 1.6 nm
- Various electron detectors (SE, BSE, intense)*

Laser Interferometer Stage

The Laser Interferometer Stage handles masks up to 7" and wafers up to 8" and features sample positioning resolution of 1 nm. Large samples are leveled by vertical piezos and – if the sample surface itself bows – optional height sensing maintains the local surface in focus at all times. The kinematic sample mount provides stable and repeatable placement for any of the application-specific sample holders.

Traxx and periodixx

The RAITH150 Two delivers a new standard for ultra high resolution large-area automated patterning. The extended functions of the proprietary traxx and periodixx writing mode* offer patterning of mm long structures or mm long periodic pattern with zero stitching error.



Waveguide coupling device with critical gap control
Courtesy: Linjie Zhou, Katsunari Okamoto, and S. J. Ben Yoo, University of California Davis, and James Conway, Stanford Nanofabrication Facility

* option

RAITH150 Two

Bridge your technology needs

- Sub-8 nm lithography
- Low kV imaging
- System automation
- Sample handling up to 8"
- Split room setup/thermostabilization
- 20-MHz digital pattern generator
- Unique continuous stitch-error free writing modes, traxx and periodixx

Product specifications

TFE filament with beam size	≤ 1.6 nm
Beam current range	5 pA–20 nA
Beam energy	20 eV–30 keV
Stage travel range	150 x 150 x 20 mm
Current density	≥ 7,500 A/cm^2
Current stability	≤ 0.5 %/8 hours
Minimum line width	< 8 nm guaranteed
Stitching accuracy	≤ 35 nm (mean +3 σ)
Overlay accuracy	≤ 35 nm (mean +3 σ)

Support and service concept

Specifications and system performance are certainly driving decisions; however, there is more to be taken into consideration to ensure an efficient start and subsequent solid support over the instrument lifetime:

All site surveys with environmental measurements, support with resulting cleanroom setup, both factory and on-site acceptances, on-site basic and advanced trainings are included. Moreover, free-of-charge application support infrastructure is available in all global time zones. Service concepts that are affordable for university environments complement these benefits.

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