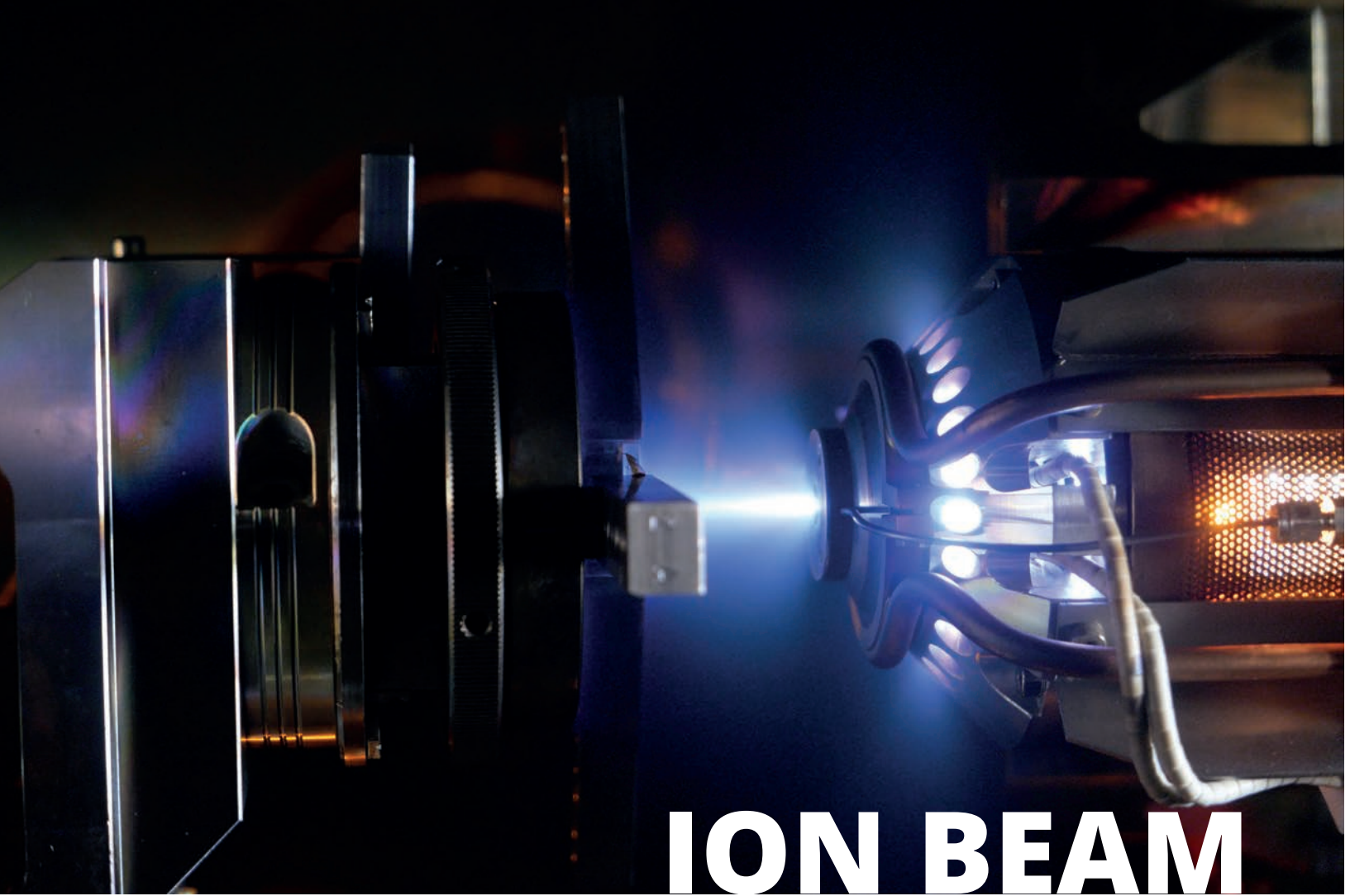




ION BEAM PROCESSING

NTG



**From concept to reality -
NTG creates high-tech
solutions that drive
industry and research
forward since 1968.**

NTG Neue Technologien GmbH & Co. KG – Your Partner for Innovative Mechanical Engineering Solutions

NTG - Neue Technologien GmbH & Co. KG, based in Gelnhausen, Germany, is a globally active medium-sized company specializing in mechanical and custom machinery engineering. Since its founding in 1968, NTG has been developing, manufacturing, and assembling tailor-made solutions for demanding industrial and research applications. Our capabilities range from producing individual components to designing complex process engineering systems – all proudly “Made in Germany”. With a dedicated team of around 160 employees, NTG focuses on quality, precision, and innovation. For further information and our entire product range, please visit our website at www.ntg.de.

Ion Beam Processing

Ion Beam Processing is a high-precision technique used for surface treatment of optical components, particularly when conventional polishing methods reach their limits. NTG - Neue Technologien GmbH & Co. KG in Gelnhausen specializes in advanced ion beam techniques, such as **Ion Beam Figuring (IBF)** and **Reactive Ion Beam Etching (R)IBE**, to achieve extremely smooth and accurate surfaces.

How NTG does it:

- A focused ion beam is directed at the surface of an optical component.
- The ions remove material at a microscopic scale, allowing precise shaping and correction of surface irregularities.
- This process can achieve nanometer-level accuracy, improving the optical performance of lenses, mirrors, and other high-precision components.
- By carefully controlling the ion beam and scanning patterns, NTG can manufacture surfaces that meet the stringent requirements of research, industry, and scientific applications.

This technology is widely used in fields such as particle physics, laser systems, and high-precision optics ...

With a dedicated team of around 160 employees, NTG focuses on quality, precision, and innovation.

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NTGmotion HIGH PERFORMANCE MOTION SOLUTIONS

2018

Mr. Franz (CEO of NTG) delegated a team of experienced engineers, a physicist, mechanical and electrical technicians to develop, design and build high performance motion components for NTG's IBF and (R)IBE machines under technical leadership of Mr. Besold (Motion Control Expert) from PriMEngineering.

June 2021

Mr. Franz and Mr. Besold founded NTGmotion GmbH & Co. KG as a separate company with the goal to further enhance the motion components and systems developed by the team to date. By the end of 2025, NTGmotion had already built approximately 200 high performance motion systems integrated in NTG's machines operating around the globe.

Located across the street from NTG, NTGmotion has enhanced its capabilities substantially by adding a software division as well as highly sophisticated measurement equipment in a temperature stabilized environment ($\pm 0.1\text{K}$), clean room capabilities and much more.

Living up to the mission statement, **INNOVATION FOR MOTION**, the company today offers a broad range of products for high performance motion solutions, ideal for precision manufacturing, test and inspection processes, as well as for scientific experiments with challenging demands for precision and/or dynamics in R&D facilities.

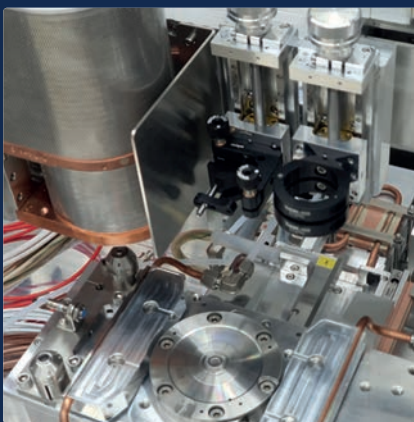
Explore: www.ntgmotion.de for further information and enjoy our interactive virtual 3D-Showroom.





The IBF 5 is designed for the nanometer-exact correction of the smallest optical surfaces. This plant was developed to improve optical components in the shortest amount of time. In addition to correcting figure errors, the plant is also suitable for MSF roughness correction and aspherization of the smallest samples. Multiprocessing of several optics is standard. A load lock is also available.

IBF 5



TECHNICAL DATA

WORKPIECE DATA

Diameter:	≤ Ø 1 mm - Ø 200 mm
Treatment Area:	100 mm x 100 mm
Thickness:	10 mm (optionally extendable)
Weight:	max. 2.5 kg
Shape:	free-form
Batch processing:	multiple workpieces one carrier

AXIS SYSTEM

Type: 5	X, Y, Z
Travel:	X = 200 mm Y > 250 mm Z = 25 mm

DIMENSIONS

Weight:	2000 kg
WxHxD:	1.3 m x 1.9 m x 1.1 m
Footprint:	3.5 m x 2.5 m

ALIGNMENT

- Vacuum Microscope
- Confocal Sensor

The IBF 200SE, which was launched in 2016, is designed for industrial use. This plant is used for the nanometer-exact correction of small-to medium-sized optical surfaces.



TECHNICAL DATA

WORKPIECE DATA

Diameter:	≤ Ø 200 mm ~ Ø 300 mm - direct loading
Thickness:	100 mm
Weight:	max. 10 kg
Shape:	free-form

SINGLE LOAD LOCK SYSTEM

Loading time:	< 3 min
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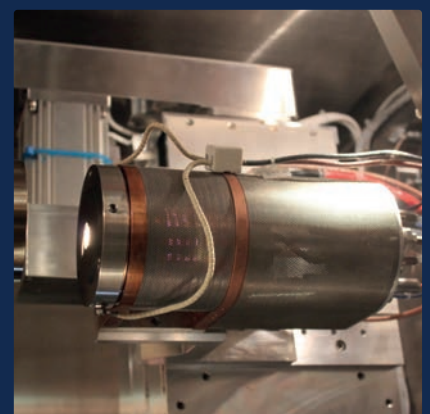
AXIS SYSTEM

Type: 200 SE	X, Y, Z
Travel:	X = 400 mm Y = 400 mm Z = 400 mm

DIMENSIONS

Weight:	3500 kg
WxHxD:	1.4 m x 2.5 m x 4.3 m
Footprint:	5.8 m x 3.4 m

IBF 200SE





The IBF 300 has proven its capabilities in various applications for more than 35 years. It was designed for multi-shift operation and series production. Modifications in recent years have improved the plant, keeping it a state-of-the-art manufacturing tool.

IBF 300



TECHNICAL DATA

WORKPIECE DATA

Diameter:	≤ Ø 300 mm
Thickness:	125 mm
Weight:	max. 30 kg
Shape:	free-form

DOUBLE LOAD LOCK SYSTEM

Load lock for two substrates, continuous process

AXIS SYSTEM

Type: 300-3	X, Y, Z
Type: 300-5	X, Y, Z, A, B
Travel:	X > 300 mm
	Y > 300 mm
	Z = 150 mm
	A ± 50°
	B ± 50°

DIMENSIONS

Weight:	2600 kg
WxHxD:	3.2 m x 2.5 m x 2.6 m
Footprint:	4.2 m x 3.5 m

The IBF 450 / 500 is the enhanced version of the IBF 300. The approved design was kept, only the diameters and weights of the workpieces were increased.



TECHNICAL DATA

WORKPIECE DATA

Diameter:	≤ Ø 450 mm / ≤ Ø 500 mm
Thickness:	IBF 450 / 125 mm IBF 500 / 150 mm
Weight:	max. 40 kg / 50 kg extended version: 100 kg
Shape:	free-form

DOUBLE LOAD LOCK SYSTEM

Load lock for two substrates, continuous process

AXIS SYSTEM

Type: 450-3 / 500-3	X, Y, Z
Type: 450-5 / 500-5	X, Y, Z, A, B
Travel:	X > 450 mm / 500 mm Y > 450 mm / 500 mm Z = 200 mm A ± 50° B ± 50°

DIMENSIONS

Weight:	4100 kg
WxHxD:	3.7 m x 3.7 m x 2.6 m
Footprint:	4.2 m x 5.2 m

IBF 450 IBF 500





The IBF 700 is a large IBF plant with a double load lock chamber. It is the third generation of NTG's IBF plants, based on the designs of the IBF 300 and IBF 450/500. This plant is approved for multi-shift (24/7) operation and series production.

IBF 700



TECHNICAL DATA

WORKPIECE DATA

Diameter:	≤ Ø 700 mm
Thickness:	200 mm
Weight:	max. 100 kg
Shape:	free-form

DOUBLE LOAD LOCK SYSTEM

Load lock for two substrates, continuous process

AXIS SYSTEM

Type: 700-3	X, Y, Z
Type: 700-5	X, Y, Z, A, B
Travel:	X > 700 mm
	Y > 700 mm
	Z = 300 mm
	A ± 50°
	B ± 50°

DIMENSIONS

Weight:	5950 kg
WxHxD:	4.7 m x 5.0 m x 2.8 m
Footprint:	6.0 m x 6.0 m

The IBF 700R is designed for the nanometer-exact correction of rectangular optical surfaces measuring up to 700 mm by 700 mm. The plant is equipped with a high-speed pumping system that minimizes loading and unloading times.



TECHNICAL DATA

WORKPIECE DATA

Size:	max. 940 mm x 940 mm
Treatment Area:	max. 700 mm x 700 mm
Diameter:	≤ Ø 700 mm
Thickness:	200 mm / 300 mm (optional)
Weight:	max. 350 kg
Shape:	free-form

HIGH-SPEED PUMPING SYSTEM

No load lock, but a high-speed pumping system including cryo generator.

AXIS SYSTEM

Type: 700R	X, Y, Z
Travel:	X > 700 mm
	Y > 700 mm
	Z > 200 mm

DIMENSIONS

Weight:	9000 kg
WxHxD:	3.1 m x 2.4 m x 2.0 m
Footprint:	6.6 m x 5.7 m

IBF 700R





The IBF 1000R is designed for the precise, nanometer-exact correction of large optical surfaces, particularly mirrors. During the process, the workpiece is oriented face down.

IBF 1000R



TECHNICAL DATA

WORKPIECE DATA

Size:	max. 1040 mm x 1040 mm
Treatment Area:	max. 1000 mm x 1000 mm
Diameter:	≤ Ø 1000 mm
Thickness:	200 mm, 300 mm, 400 mm (optional)
Weight:	max. 350 kg, max. 450 kg (optional)
Shape:	free-form

HIGH-SPEED PUMPING SYSTEM

No load lock, but a high-speed pumping system

AXIS SYSTEM

Type: 1000R	X, Y, Z
Travel:	X > 1000 mm
	Y > 1000 mm
	Z > 200 mm

DIMENSIONS

Weight:	10000 kg
WxHxD:	3.5 m x 2.7 m x 2.0 m
Footprint:	6.5 m x 9.0 m

Bigger workpieces, more precise, more powerful - engineered for next-level performance.

The IBF 1200R is designed for larger workpieces with nanometer-exact correction of rectangle optical surfaces up to 1200 mm x 1200 mm. The plant is equipped with a high-speed pumping system to minimize loading and unloading times. The integrated Gantry System from NTGmotion provides more power and precision, and is engineered for next-level performance.



TECHNICAL DATA

WORKPIECE DATA

Size:	max. 1240 mm x 1240 mm
Treatment Area:	1200 mm x 1200 mm
Diameter:	≤ Ø 1200 mm
Thickness:	max. 200 mm, (optional: 300 mm)
Weight:	max. 350 kg (incl. holder)
Shape:	free-form

HIGH-SPEED PUMPING SYSTEM

No load lock, but a high-speed pumping system

AXIS SYSTEM

Type: 1200R	X, Y, Z
Travel:	X ≥ 1300 mm, XL type, gantry, direct driven Y ≥ 1300 mm, XL type, direct driven Z ≥ 250 mm, XS 27 type, spindle driven

DIMENSIONS

WxHxD:	7.9 m x 2.5 m x 7 m
Footprint:	9.5 m x 8.7 m
Weight:	17000 kg

IBF 1200R



XG20 -1300 3-Axes Gantry from NTGmotion

- 3D Accuracy 14µm in workspace
- Workspace: 1.2m x 1.2m (horizontal); 0.25m (vertical)
- Max. speed: 200mm/s
- Max. acceleration: 1m/s²
- 100kHz position servo loop
- Advanced MIMO control



The IBF 1000R/ LLC 500 is designed for the nanometer-exact correction of rectangular optical surfaces measuring up to 1000 mm x 1000 mm. The plant is equipped with a high-speed pumping system that minimizes loading and unloading times. Additionally, workpieces with a diameter of up to 500 mm can be fed directly into the vacuum via a laterally mounted load lock. This setup provides shorter pumpdown times, and the ion source does not require additional warm-up time.

IBF 1000R/ LLC 500



TECHNICAL DATA

WORKPIECE DATA

Size:	max. 1040 mm x 1040 mm
Treatment Area:	max. 1000 mm x 1000 mm
Diameter:	≤ Ø 1000 mm
Thickness:	200 mm, 300 mm (optional)
Weight:	max. 350 kg, max. 450 kg (optional)
Shape:	free-form

HIGH-SPEED PUMPING SYSTEM

Load lock and high-speed pumping system

AXIS SYSTEM

Type: 1000R	X, Y, Z
Travel:	X > 1000 mm
	Y > 1000 mm
	Z > 200 mm

DIMENSIONS

Weight:	11300 kg
WxHxD:	3.5 m x 3.8 m x 2.4 m
Footprint:	9.5 m x 8.5 m

The IBF 1500 is designed for the nanometer-exact correction of large optical surfaces, particularly mirrors. The workpiece orientation is vertical.



TECHNICAL DATA

WORKPIECE DATA

Size:	≤ Ø 1500 mm
Thickness:	520 mm
Weight:	max. 1000 kg
Shape:	free-form

HIGH-SPEED PUMPING SYSTEM

No load lock, but a high-speed pumping system

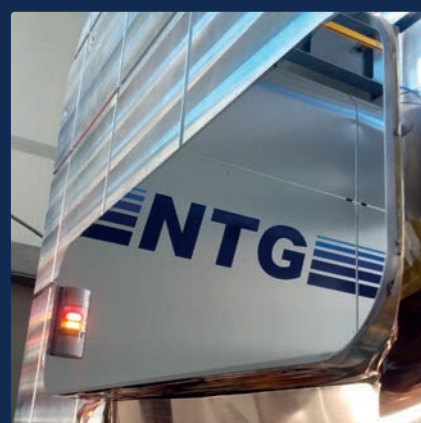
AXIS SYSTEM

Type: 1500-3	X, Y, Z, A (manually)
Travel:	X > 1650 mm
	Y > 1800 mm
	Z > 200 mm

DIMENSIONS

Weight:	21300 kg
WxHxD:	3.5 m x 3.2 m x 3.9 m
Footprint:	8.0 m x 8.0 m

IBF 1500





The IBF 1500R is designed for the nanometer-exact correction of rectangular optical surfaces, such as synchrotron mirrors. The plant is equipped with a high-speed pumping system that minimizes loading and unloading times.

IBF 1500R

TECHNICAL DATA

WORKPIECE DATA

Size:	max. 1500 mm x 550 mm
Area Treatment:	1500 mm x 500 mm
Thickness:	200 mm / 300 mm (optional)
Weight:	max. 50 kg / 350 kg (optional)
Shape:	free-form

HIGH-SPEED PUMPING SYSTEM

No load lock, but a high-speed pumping system

AXIS SYSTEM

Type: 1500R	X, Y, Z, A (manually)
Travel:	X > 1600 mm
	Y > 600 mm
	Z > 250 mm

DIMENSIONS

Weight:	21300 kg
WxHxD:	3.5 m x 3.2 m x 3.9 m
Footprint:	8.0 m x 8.0 m



The IBF 2000 is designed to correct large optical surfaces, especially mirrors for space applications. During the process, the workpiece is oriented face down. It is the largest NTG IBF plant; larger ones are available upon request.



TECHNICAL DATA

WORKPIECE DATA

Size:	max. 2000 mm x 2000 mm
Thickness:	600 mm
Weight:	max. 1000 kg
Shape:	free-form

HIGH-SPEED PUMPING SYSTEM

No load lock, but a high-speed pumping system

AXIS SYSTEM

Type: 2000-3	X, Y, Z
Travel:	X = 2100 mm
	Y = 2100 mm
	Z = 400 mm

DIMENSIONS

Weight:	26500 kg
WxHxD:	3.9 m x 3.9 m x 2.6 m - chamber
Footprint:	8.5 m x 6.0 m

IBF 2000



ION BEAM ETCHING FOR MICRO STRUCTURING AND SMOOTHING OF OPTICAL SURFACES

ION BEAM ETCHING PLANT (R)IBE 215:

Substrate dimensions: up to 215 mm diameter
thickness 20 mm, 2 kg max.

ION BEAM ETCHING PLANT (R)IBE 450:

Substrate dimensions: up to 450 mm diameter
thickness 50 mm, 50 kg max.

ION BEAM FIGURING AND ETCHING PLANT IBF 350 RE:

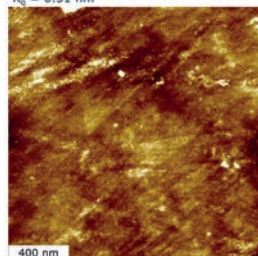
Substrate dimensions: up to 350 mm diameter
thickness 150 mm, 6 kg max.

GENERAL SPECIFICATIONS:

- Graphical user interface (including recipes)
- Water cooling via contact pad
- Substrate rotatable: max. speed of 10 rpm, tilt 0° - 90°
- High current beam neutralizer
- Kaufman-type or RF-type ion beam source (both for IBF 350 RE)
- Beam-monitoring with Faraday Cup array
- Homogeneity of etching rate within 120 mm diameter < 5%
- Multi-gas IBE- and RIBE- processing with F- and O- containing gases
- Clean room interface
- Load lock chamber

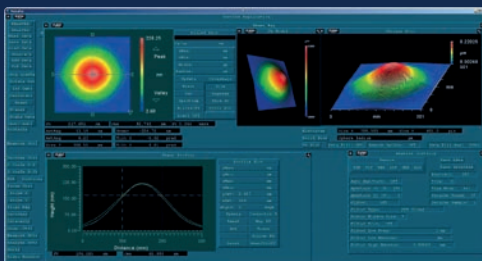
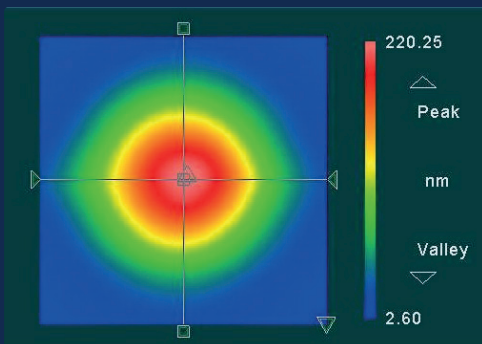
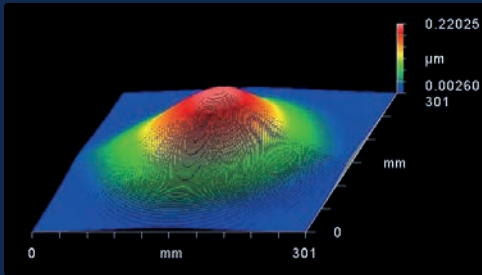
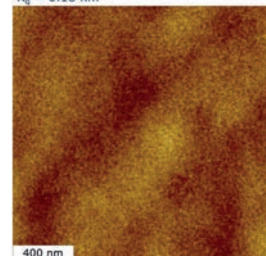
Si- Smoothing example

$R_q = 0.31 \text{ nm}$



10 min processing time

$R_q = 0.18 \text{ nm}$



The (R)IBE 215 is designed for both inert gas ion beam etching and reactive ion beam etching. It has back-side cooling, SIMS for endpoint detection, a clean room interface, and a Faraday Cup array for beam monitoring, as well as other equipment.



TECHNICAL DATA

WORKPIECE DATA

Size:	Ø 215 mm - 152.4 mm x 152.4 mm
Thickness:	20 mm
Weight:	max. 2 kg
Contact angle:	0 - 90°
Rotation speed:	0 - 10 rpm
Shape:	free-form

SINGLE LOAD SYSTEM

Loading time:	< 2 min
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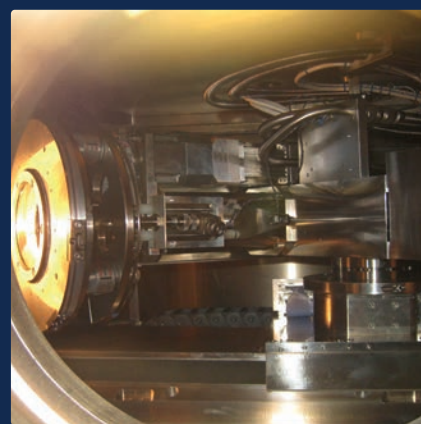
AXIS SYSTEM

Type: 215	X, Y, A, B
Travel:	X > 500 mm
	Y = 300 mm
	A ± 95°
	B = continuous

DIMENSIONS

Weight:	2000 kg
WxHxD:	2.8 m x 2.4 m x 1.4 m
Footprint:	4.0 m x 2.0 m

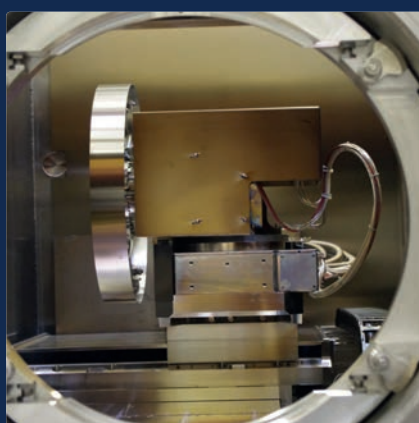
(R)IBE 215





The (R)IBE 450 is designed for both inert gas ion beam etching and reactive ion beam etching. Additional features include backside cooling, SIMS for endpoint detection, a clean room interface, and beam monitoring with a Faraday Cup array.

(R)IBE 450



TECHNICAL DATA

WORKPIECE DATA

Size:	Ø 450 mm
Thickness:	50 mm
Weight:	max. 50 kg
Contact angle:	0 - 90°
Rotation speed:	0 - 10 rpm
Shape:	free-form

HIGH-SPEED PUMPING SYSTEM

Loading time:	< 2 min
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AXIS SYSTEM

Type: 450	X, Y, Z, A, B
Travel:	X = 1100 mm
	Y = 500 mm
	Z = 300 mm
	A = 0 - 90°
	B = continuous

DIMENSIONS

Weight:	7000 kg
WxHxD:	2.5 m x 3.6 m x 2.0 m
Footprint:	4.0 m x 4.0 m

The ISA 200 is designed for both inert gas ion beam etching and reactive ion beam etching. Additional features include backside cooling, workpiece heating, SIMS for endpoint detection, CAIBE, a clean room interface, and a Faraday Cup array for beam monitoring.

A second ion source can be attached to combine the etching process with an ion-beam-assisted coating process via up to four sputter targets.



TECHNICAL DATA

WORKPIECE DATA

Size:	Ø 200 mm
Thickness:	50 mm
Weight:	max. 2 kg
Contact angle:	0 - 180°
Rotation speed:	0 - 10 rpm
Shape:	free-form

SINGLE LOAD LOCK SYSTEM

Loading time:	< 2 min
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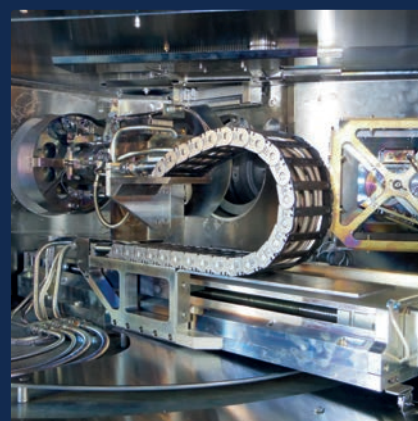
AXIS SYSTEM

Type: 200	X, A, B
Travel:	X = 300 mm
	A = 0 - 120°
	B = continuous

DIMENSIONS

Weight:	2200 kg
WxHxD:	2.6 m x 2.5 m x 2.5 m
Footprint:	3.5 m x 3.0 m

ISA 200





The IBF 350 RE is designed for form error correction on nanometer scale and additionally for inert gas ion beam etching as well as for reactive ion beam etching. Backside cooling, workpiece heating, SIMS for end point detection, interface for clean room, beam monitoring with Faraday Cup array and other additional features are available.

IBF 350RE



TECHNICAL DATA

WORKPIECE DATA

Size:	Ø 350 mm
Thickness:	150 mm
Weight:	max. 8.5 kg
Contact angle:	0 - 90°
Rotation speed:	0 - 10 rpm
Shape:	free-form

LOAD LOCK SYSTEM

Loading time:	< 2 min
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AXIS SYSTEM

Type: 350	X, Y, Z, B, C
Travel:	X = 500 mm
	Y = 500 mm
	Z = 600 mm
	B = 0 - 90°
	C = continuous

ION BEAM SOURCES

Type K 100 and Type RF 40

DIMENSIONS

Weight:	2200 kg
WxHxD:	2.6 m x 2.5 m x 2.5 m
Footprint:	3.5 m x 3.0 m

ION BEAM SOURCES AND ACCESSORIES

The RF 40, RF 60, K 100 and RF 5 Ion Beam Sources are especially designed for the use in our IBF and IBE plants. Beside a proven long-term stability, they are maintenance free for about at least 500 working hours (50 h for K 100).

RF 40 ION BEAM SOURCE

Designed for IBF plants:	IBF 100 - IBF 2000
Ion energy:	600 eV - 2000 eV (Argon)
Ion beam:	Gaussian shape
Small beam:	Ø 0.5 mm - Ø 4 mm (FWHM)
Standard:	Ø 5 mm - Ø 25 mm (FWHM)
High Power:	Ø 8 mm - Ø 25 mm (FWHM)
Typ. volume removal rate*:	
Ø 0.5 mm:	approx. 2e-5 mm ³ /min
Ø 25 mm:	approx. 0.3 mm ³ /min
High Power Ø 25 mm:	approx. 1 mm ³ /min
Maintenance free:	> 500 hours

RF 60 ION BEAM SOURCE

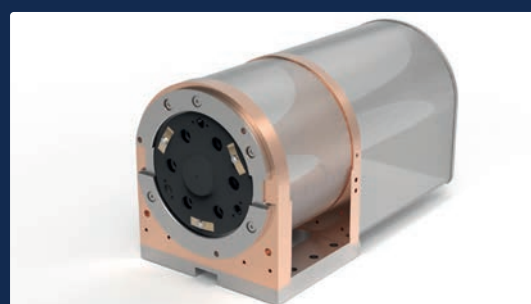
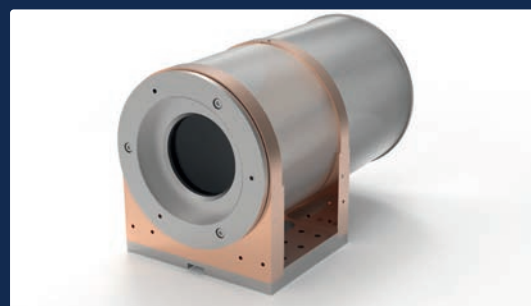
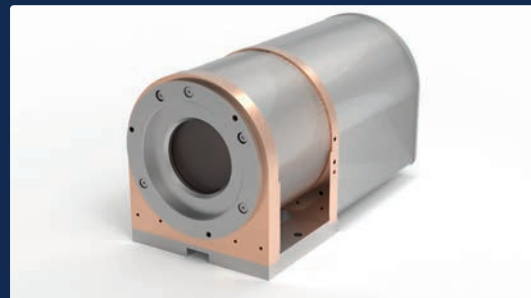
Designed for IBF plants:	IBF 300 - IBF 2000
Ion energy:	600 eV - 1300 eV (Argon)
Ion beam:	Gaussian shape
	Ø 30 mm - Ø 50 mm (FWHM)
Typ. volume removal rate*:	
High Power Ø 35 mm:	0.4 mm ³ /min (FWHM)
Maintenance free:	> 250 hours

K 100 ION BEAM SOURCE

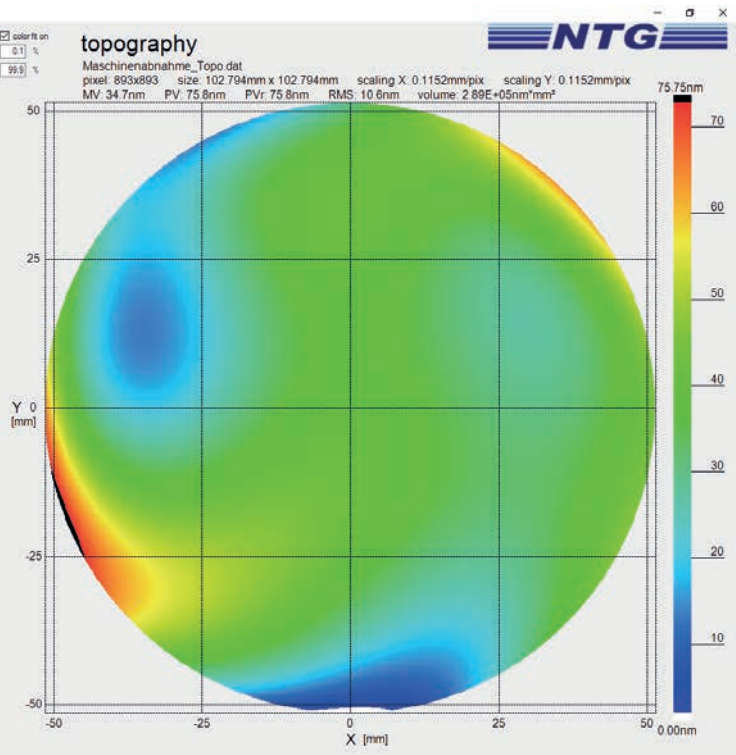
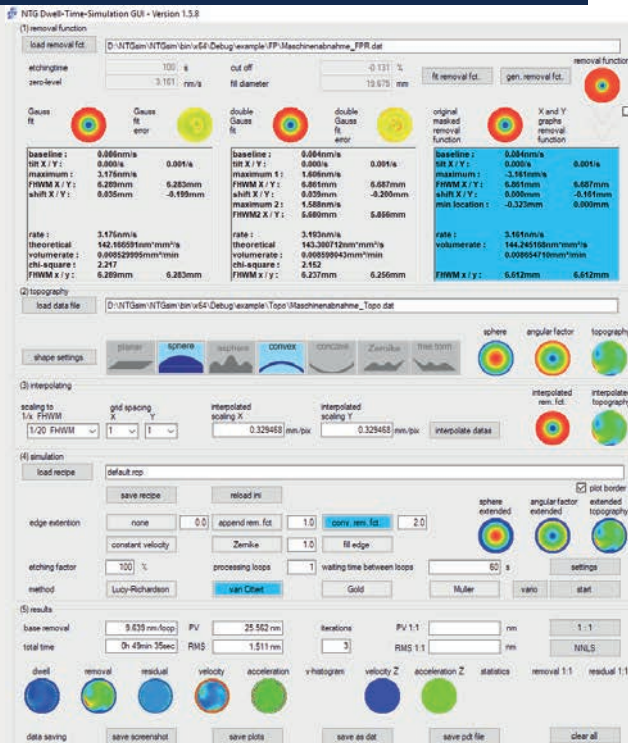
Designed for IBF plants:	IBE 215 / IBE 450 (flange mounted) (IBE 215 flange mounted)
Ion energy:	600 eV - 1200 eV (Argon)
Ion beam:	Gaussian shape
	Ø 60 mm - Ø 120 mm (FWHM)
Typ. volume removal rate*:	
	1.0 mm ³ /min - 3.0 mm ³ /min
Maintenance free:	50 hours

RF 5 ION BEAM SOURCE

Designed for IBF plants:	IBF 5
Ion energy:	1000 eV - 3000 eV (Argon)
Ion beam:	Gaussian shape
	20 µm - 400 µm (FWHM)
Typ. volume removal rate*:	
	Ø 40 µm: 0.17 mm ² nm/s
	Ø 100 µm: 0.7 mm ² nm/s
Maintenance free:	1500 hours

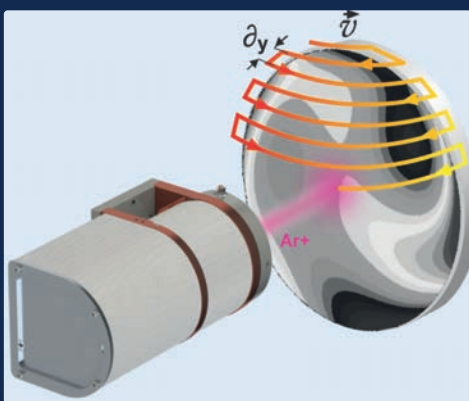


*relating to fused silica



NTGsim - ION BEAM FIGURING SIMULATION SOFTWARE FOR OPTICAL SURFACE MANUFACTURING

- REMOVAL FUNCTION ESTIMATION
- FIGURING EVALUATION
- ETCH PROCESS SIMULATION
- EXTENDED PROCESS DYNAMICS SIMULATION



The "NTG IBF Simulation Program" calculates the dwell times for the Ion Beam Figuring of surfaces on planar, spherical, conical, aspherical and free-form workpieces using a linear 3-or 5-axis system. It computes the matrix of the dwell times map, the removal function and the output topography under consideration of the plant parameters and the quality parameters of the target topography. The moving path is meander-shaped (row- or column-wise). The path velocity is proportional to the desired material removal. The processing software developed at NTG is based on a direct forwarding calculation. All deconvolution methods are computed on an equidistant grid and can be calculated from double sums. These calculations are parallelized with the Intel Fortran Compiler, uses Intel® math kernel library and in addition OpenMP®.

MODULES FOR ION BEAM FIGURING SIMULATION SOFTWARE

FILETYPES

We can adapt our software to all specific customers data files, as standard binary MetroPro© files. It is possible to load different planar (XYdZ) ASCII formats with mask information optionally. Additionally, NTGsim can read the dZ information out of the colour scale from an image file.

FREE-FORM

The description of free-form surfaces (XYZdZ) is possible with ASCII formats or UA3P© files.

SURFACE DESCRIPTIONS

The surface (Z) of the sample can be described by several equations.

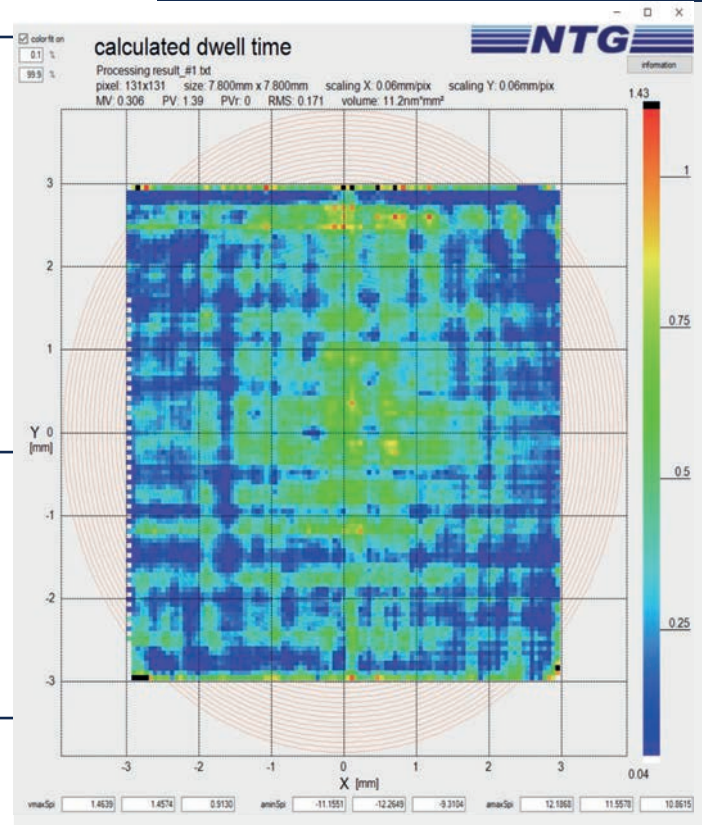
- Radial R- asphere
- X dependence - asphere
- Y dependence - asphere
- Mixed XY - asphere
- Fringe Zernike (Z66) with C and K
- Standard Zernike (Z66) polynomial

MULTI-FILE WORKFLOW

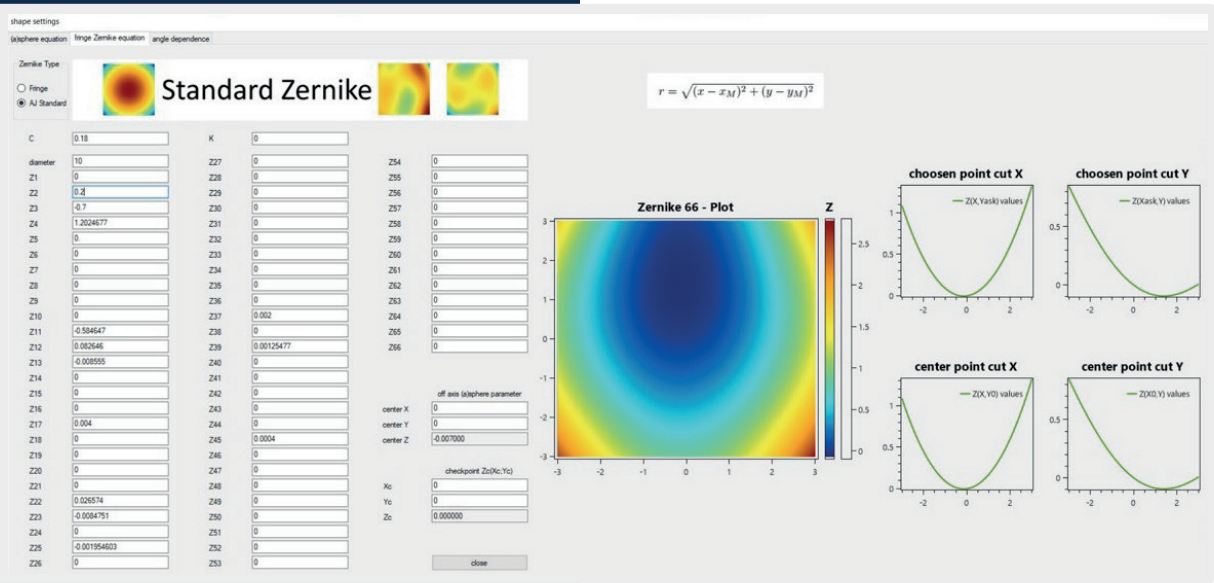
An extra GUI window allows the handling of many different samples on one target holder. All sample files will be calculated individually but processed in one long run.

MULTI-FOOTPRINT GENERATOR AND ANALYSIS

A multiple process run with various footprint settings can be read and analyzed. An Excel© sheet with all footprints parameters is generated.



MODULES FOR ION BEAM FIGURING SIMULATION SOFTWARE



SPHERE APPROXIMATION

All surface descriptions can be approximated to a sphere. This can smooth the outer regions and the edge extension area.

ORIGINAL FOOTPRINT OR GROOVE USAGE

The original footprint data can be used if the ion beam is distorted in shape. It is possible to load X- or Y-groove etching data and the footprint shape is generated.

CONSTANT REMOVAL

Generates constant removals in circular and rectangular shape.

ONE-TO-ONE CALCULATION

After the simulation process the removal can be calculated in the original resolution of the topography. This enables checking various scalings and calculating the absolute etching depth.

WORKING DIRECTIONS

Depending on topography data to be corrected, it can make sense to change the working direction in the calculation process for better results.

SPIRAL PATH

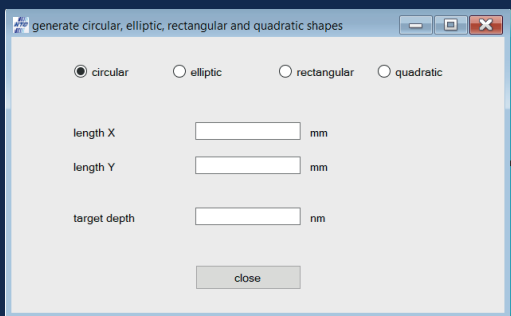
The moving path is a spiral or a double spiral (in-and-out). It is possible to etch toric or ring surfaces.

VARIATION OF METHODS AND EDGE EXTENSIONS

The vario-module combines all methods, extensions, iteration steps and pertinent settings for finding the best result. The ratio between goal PV and RMS value can be weighted.

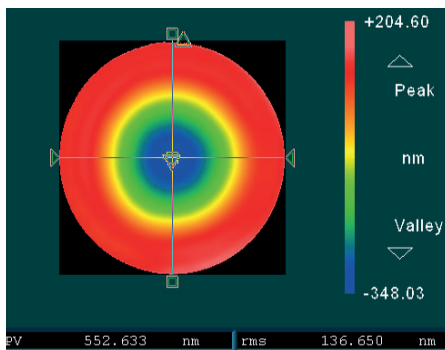
USER PERMISSION

It is possible to award different permissions for Admin, Expert or Worker users. Settings are blocked and the automatic recipe modus takes over.



FEASIBILITY STUDY: ION BEAM PROCESSING OF SYNTHETIC DIAMOND

INPUT TOPOGRAPHY:



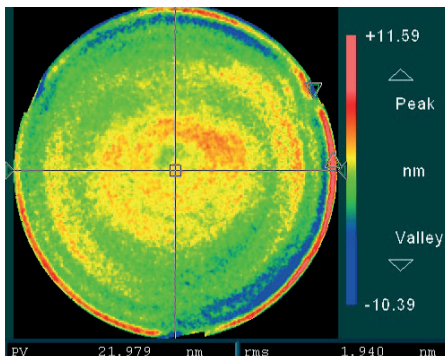
Ø: 74.1 mm
PVR: 543.9 nm
RMS: 136.7 nm

$PVr \sim \lambda$
 $RMS \sim \lambda/5$



2 step IBF
FWHM: 11 mm + 4 mm
IBF time: 6 h + 3 h

OUTPUT TOPOGRAPHY:



Ø: 74.1 mm
PVR: 16.37 nm
RMS: 1.94 nm

$PVr \sim \lambda/40$
 $RMS \sim \lambda/330$

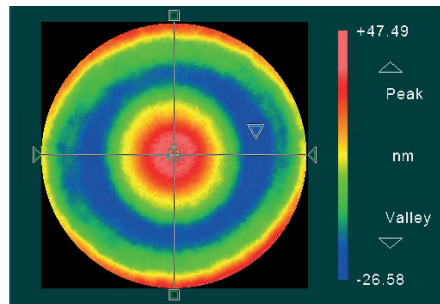
FEASIBILITY STUDY FOR CUSTOMERS:

Special chemical assisted processing enables effective ion beam treatment of diamond with removal rates equal to fused silica. No alternative processing methods are available to achieve $PVr \sim \lambda/40$.



JOB ORDER PRODUCTION: ION BEAM FIGURING OF CONCAVE MIRROR (F3.0, ULE MATERIAL)

INPUT TOPOGRAPHY:



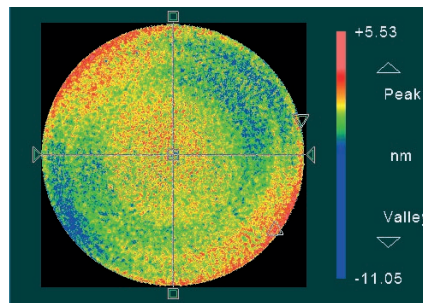
R: 600 mm
 Ø: 192 mm
 PVr: 74.1 nm
 RMS: 15.16 nm

PVr ~ $\lambda/9$
 RMS ~ $\lambda/40$



1 step IBF
 FWHM: 6.4 mm
 IBF time: 1:59 h

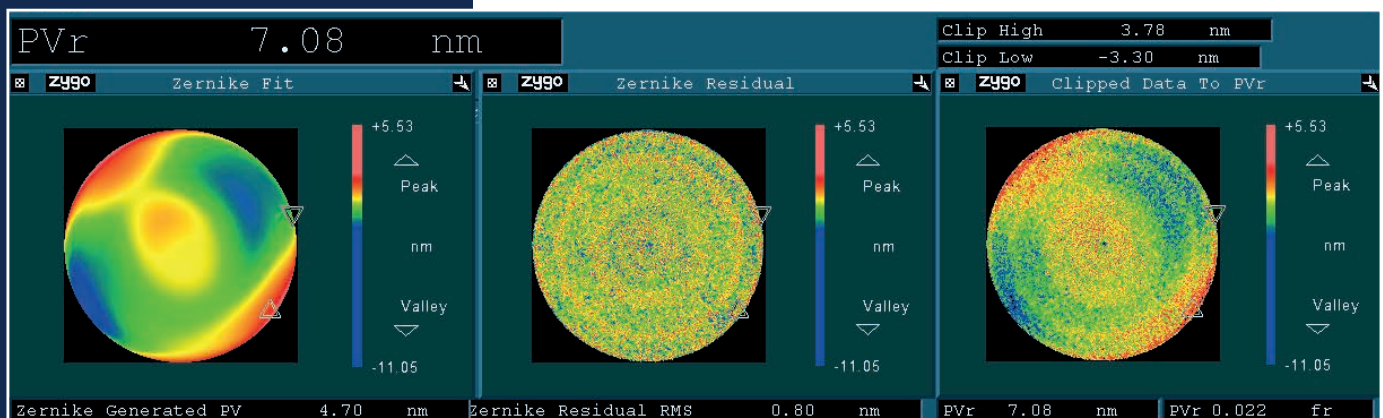
OUTPUT TOPOGRAPHY:



Ø: 192 mm
 PVr: 7.1 nm
 RMS: 1.1 nm

PVr ~ $\lambda/90$
 RMS ~ $\lambda/575$

MEASUREMENT REPRODUCIBILITY REACHED!



ONLY ONE PROCESSING ITERATION USING
 6MM ION BEAM TOOL IS USED TO ACHIEVE
 HIGHEST PRECISION.

IBF LABORATORY

IBF LAB

In 2009 NTG started in-house IBF processing with the first IBF Lab. The facility includes various ion beam processing systems, which can be used to perform a wide range of services such as the finishing of high-performance optics and research and development projects for new materials and applications.

NEW IBF LAB

In 2026/2027 our new IBF Lab will be ready to use. On an area of approx. 400 sqm several machines and metrology equipment will be available, such as:

IBF - plants:

- IBF 300
- IBF 500
- IBF 700R
- IBF 200SE
- IBF 200 first generation
- IBF 5
- IBF 5 first generation

Meterology:

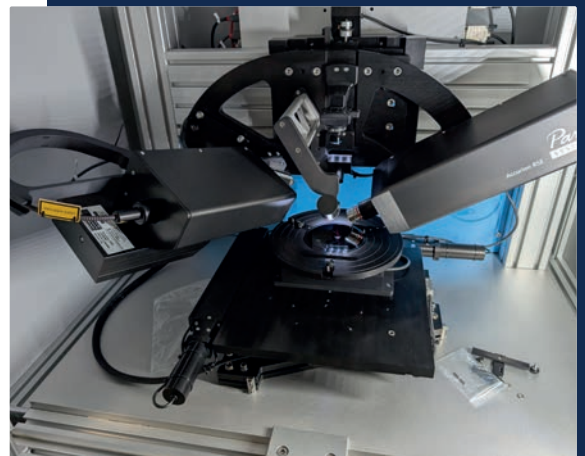
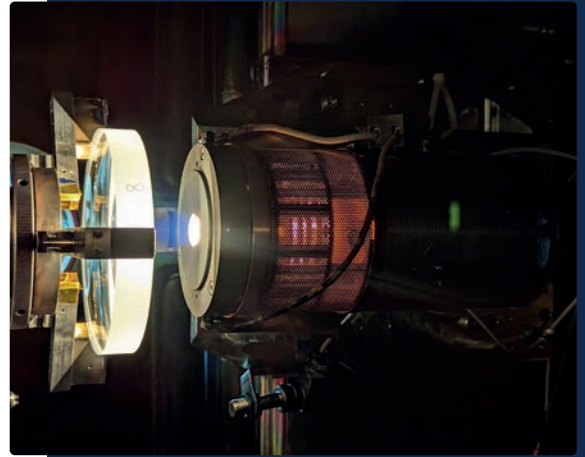
- 4" Zygo Verifire MST+
- 4" Zygo Verifire AT+

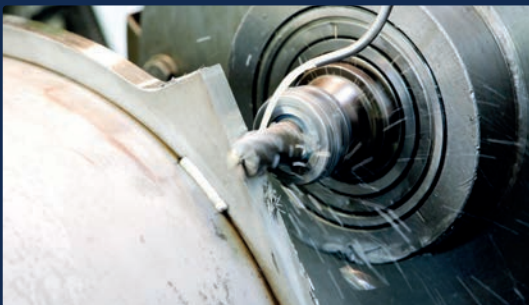
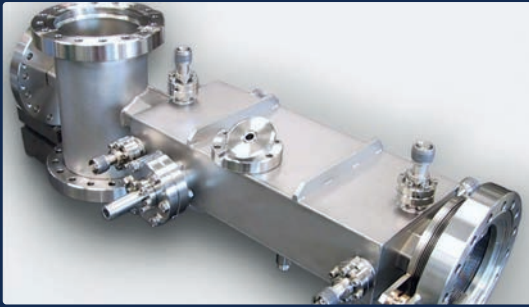
Several Measurement Condensers and Adapter (4" and 6") ranging from F0.55 to F2.2 and flat (incl. ASML Reference Optics)

Ellipsometer based Reflectometer Park Accurion RSE

Park XE-150 AFM

MicroXAM-100 WLI





**WE LOOK FORWARD TO
RECEIVING YOUR INQUIRIES**

BEYOND IBF

VACUUM TECHNOLOGY

Vacuum Technology is one of the core competences of NTG. Whenever “nothing” is required we can provide a solution, mainly in the field of Ultra High Vacuum applications. NTG can provide solutions for nearly any requirement. Additionally to UHV-chambers, we offer a wide range of accessories such as motion systems for any kind of vacuum application. As a speciality we offer Aluminum-Chambers with stainless steel CF-flanges. For this type of chambers we use the in-house developed Bi-Metal-flanges.

PARTICLE ACCELERATORS

NTG has great experience in the field of accelerator design and manufacturing. We cover all aspects of the design process from beam dynamics and RF-design to thermal calculations and technical layouts. We also offer high precision manufacturing, and we work with most modern measuring tools, such as laser trackers, for assembly. Finally, our team has extensive experience in RF measurement and tuning techniques, such as bead perturbation measurements, to deliver accelerator structures ready for operation.

BEAM DIAGNOSTICS

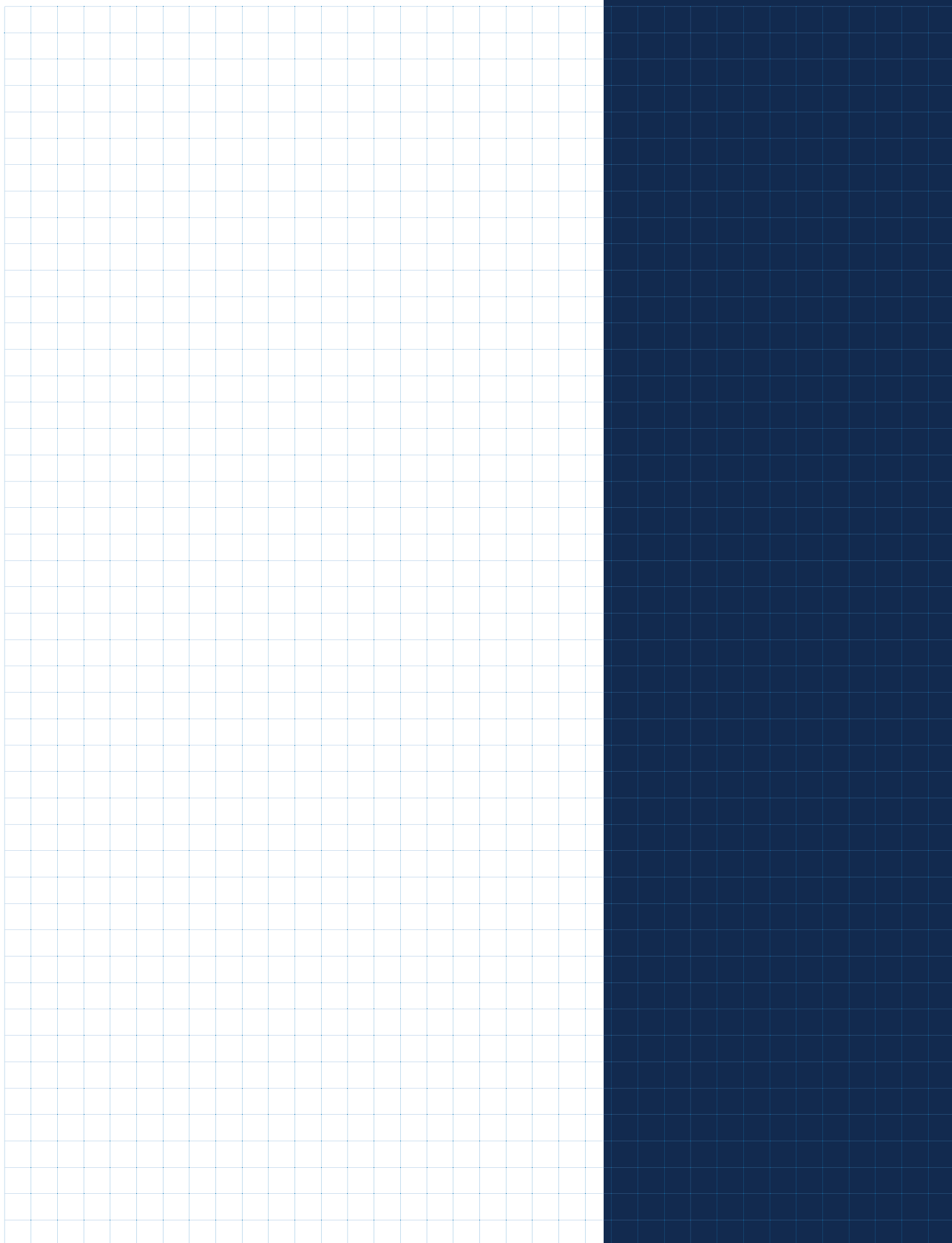
Beam diagnostics have a long tradition at NTG. We offer a wide range of state-of-the-art devices, and customization is standard for us. Based on your beam parameters and desired measurement accuracy we provide tailored solutions. Our diagnostic elements include Faraday Cups (beam stoppers or coaxial cups), profile grids, and capacitive pickups such as phase probes.

CUSTOMIZATION

We develop and manufacture many things others are unwilling or are unable to do. Customized products are a specialty of NTG. NTG is your right partner to manufacture prototypes or other unique parts. NTG tries to make new ideas possible. Tell us your requirement and we will try to find a solution.

JOB ORDER PRODUCTION

In addition to the equipment and components described at our product pages, NTG provides capacities in the service sector. An extensive machine park allows work on a subcontract basis. The focus here is on stainless steel and aluminum processing. This results in a certain stock of materials. Thus, we are able to respond to customer requests on short term. In addition to stainless steel processing, we are also capable of special materials, such as ... tantalum, titanium, zircaloy, copper, Inconel, oxide ceramic, etc.



IBF CHECKLIST

#1

Max. size of workpiece: [mm]
Min. size of workpiece: [mm]

#2

Max. thickness of workpiece: [mm]
Min. thickness of workpiece: [mm]
Sag:

#3

Max. weight of workpiece: [kg]

#4

Shape:
Flat, concave, convex:
Radius of curvature: [mm]
Spherical, aspherical, free-form:

#5

Input values before IBF:
PV-value or PVr-value: [nm]
RMS-value: [nm]
What kind of metrology is available:
Format of metrology data:

#6

Target values after IBF:
PV-value: [nm]
RMS-value: [nm]

IBF CHECKLIST

#7

Required throughput of the machine:

Parts per day:

Parts per week:

#8

Load lock chamber required:

#9

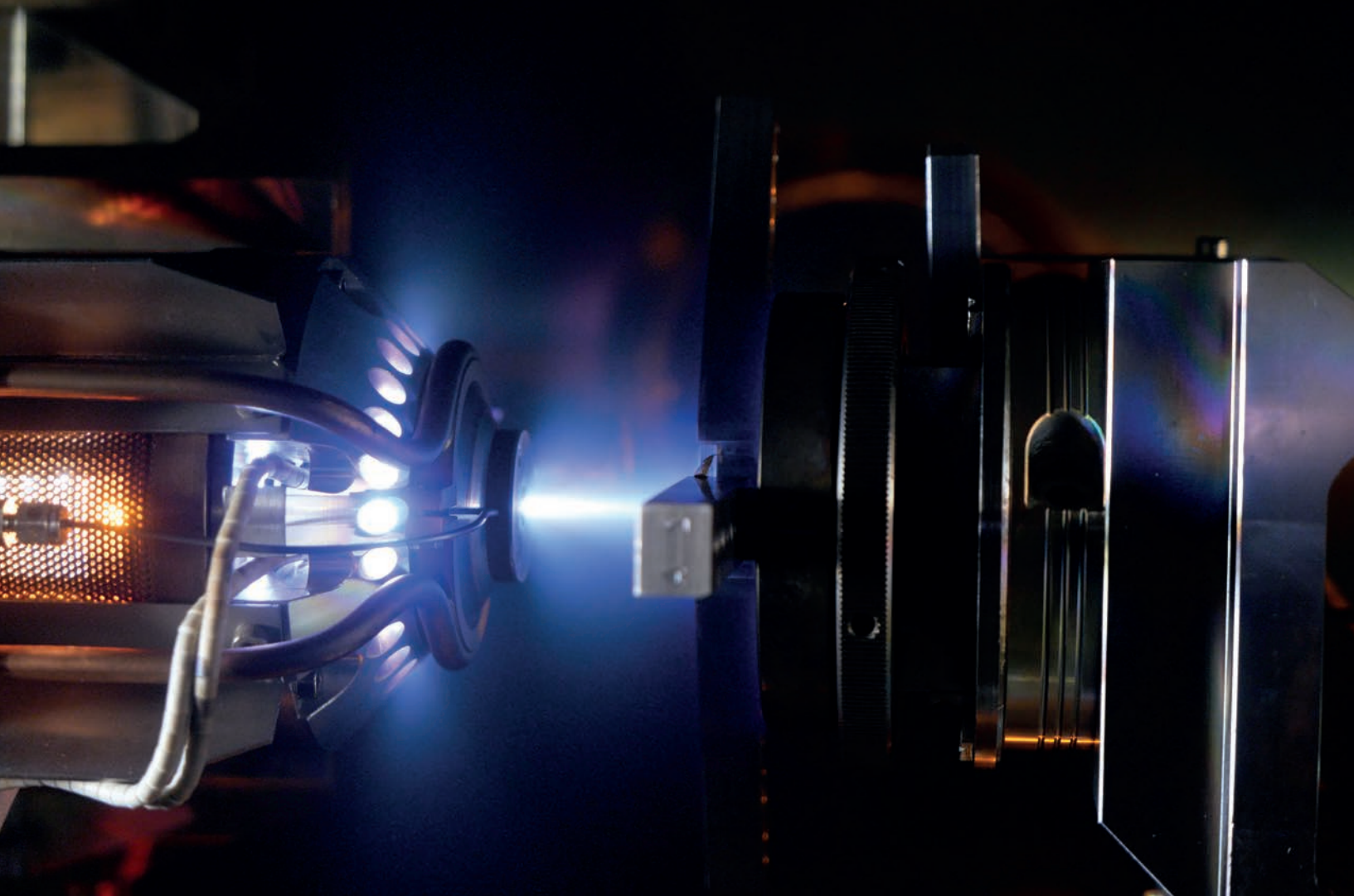
Intended project start:

Requested lead time: [month]

#10

Materials to be treated:

Sorted by importance:



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