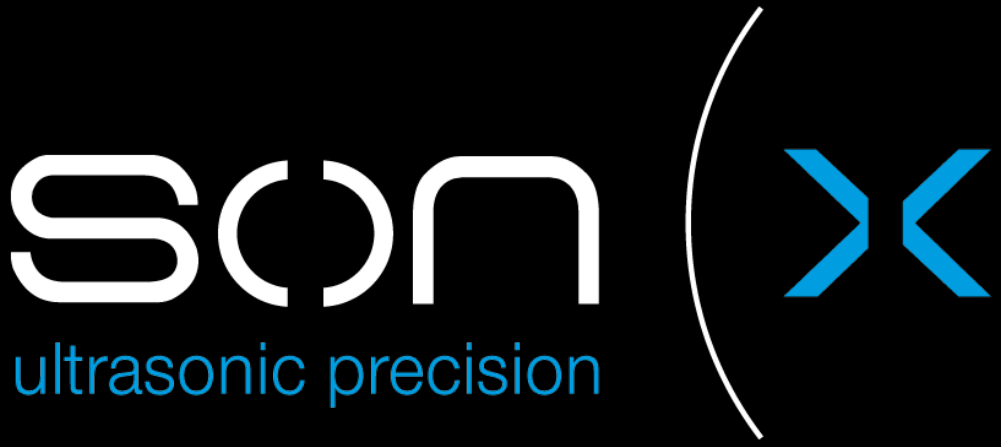


New benchmark in ultra precision

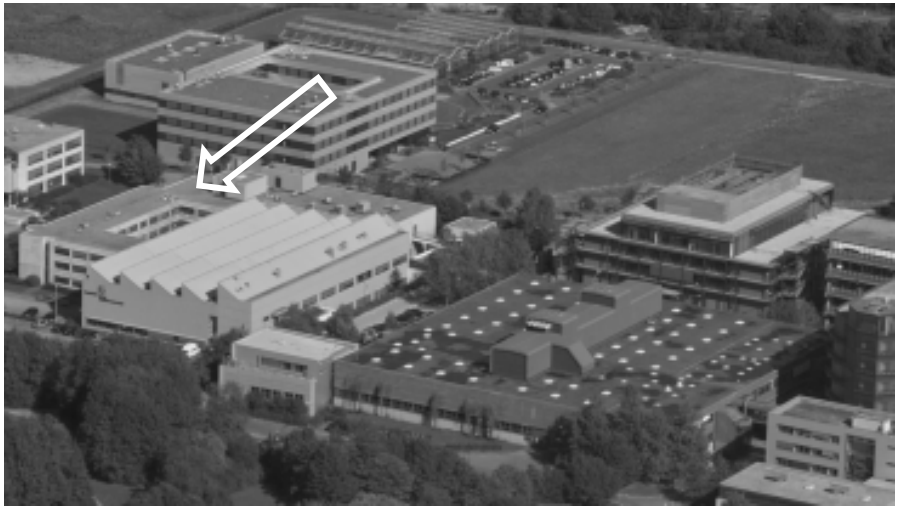
Dr.-Ing. Benjamin Bulla

Content

son x ultrasonic precision

Company profile

- son-x GmbH founded in 2011 and started active business in 2012.
- Spin-off company of Fraunhofer IPT in Aachen.
- Private owned 100%



Push the Boundaries in Ultra Precision Technology

- Innovative equipment enabling new processes
- Efficient manufacturing enabling new products

son x
ultrasonic precision

Business fields

son-x systems

- Ultrasonic assisted machining equipment
- Finishing equipment
- Machine independent
- Plug&Play
- User friendly & efficient

son-x precision

- Optical steel inserts for injection moulding
  (Imaging, lightning, automotive…)
- High precision steel components
- Measurement Standards
- Mirrors, prototypes, etc.

son x
ultrasonic precision

Content

son x ultrasonic precision

Ultra precision machining with single crystal diamond

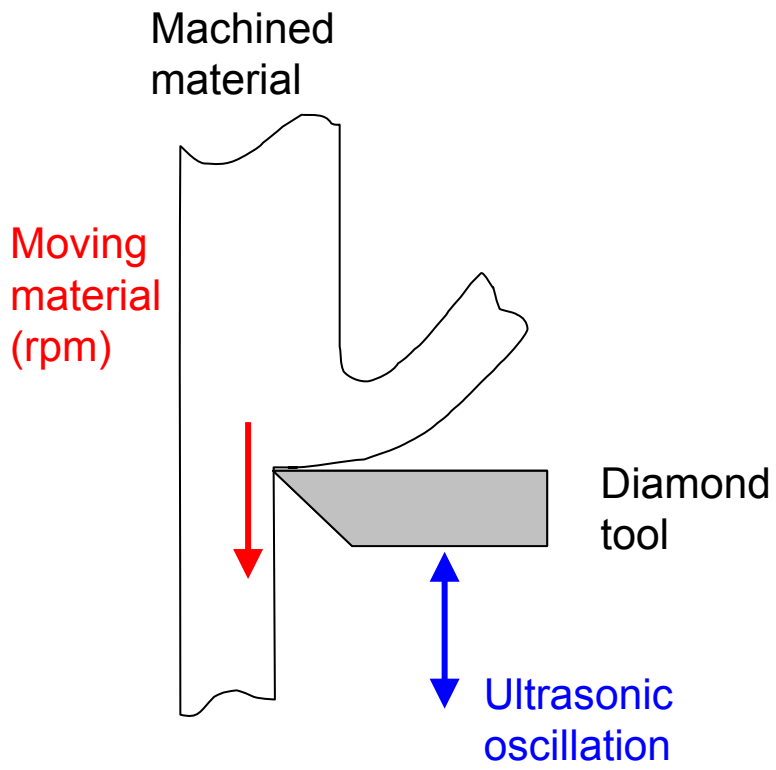
- Very high geometrical freedom
  - Spheres & aspheres
  - Microstructures (diffractive, fresnel)
  - Non rotational symmetric geometries (freeforms, waves)
  - A combination of …
- Surface roughness (Ra < 3 nm)
- Form accuracy (P-V < 200 nm)
- Different transmissive and reflective materials can be manufactured
- Machining of steel is not possible

Ultrasonic assisted machining makes it possible

son x ultrasonic precision

Schematic of the ultrasonic assisted process

- Better tool cooling
- Intermitting chemical interactions
- Less friction and forces
- Reduced tool wear



Content

son x ultrasonic precision

Equipment: The Ultrasonic Tooling System

The UTS2

- Working frequency **100 kHz.**
- No geometric constraints.
- The UTS2 can be integrated into all standard, commercial UP-machines.
- Optional micro height adjustment.
- Highest stiffness.
- Automatic high performance piezo regulation.

Designed, manufactured & assembled in Germany

son x ultrasonic precision

Integration of the UTS2 into the machine

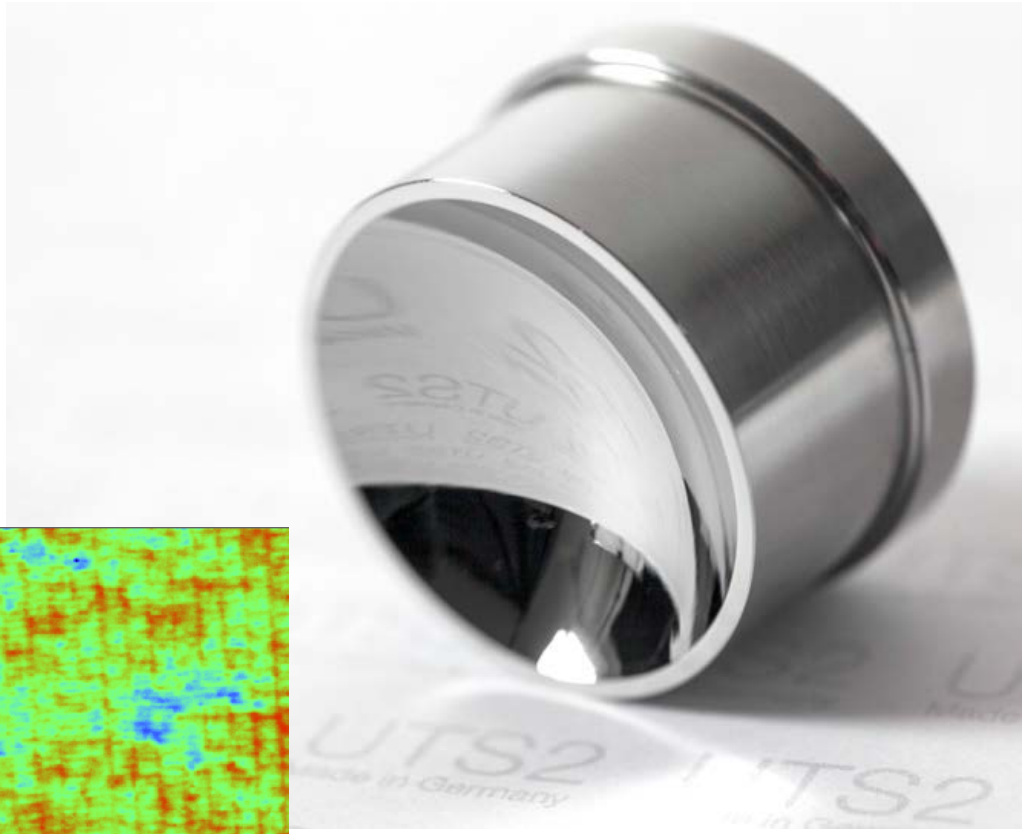
- The system is mounted on the Z-axis.
- Generator placed outside the machine.
- If no vertical Y-axis available, a micro height adjustment is optional.
- All diamond tool geometries which are typically possible.

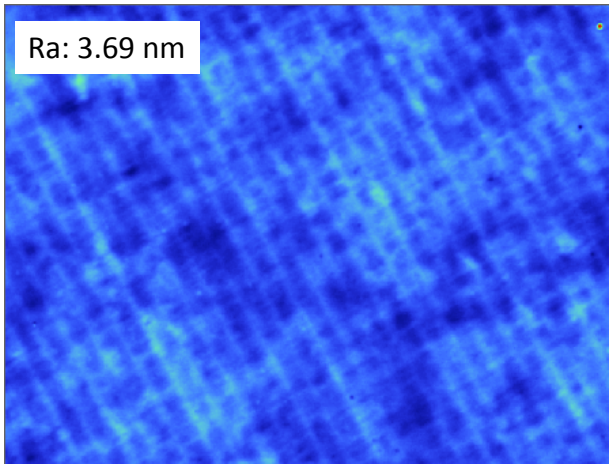
son x ultrasonic precision

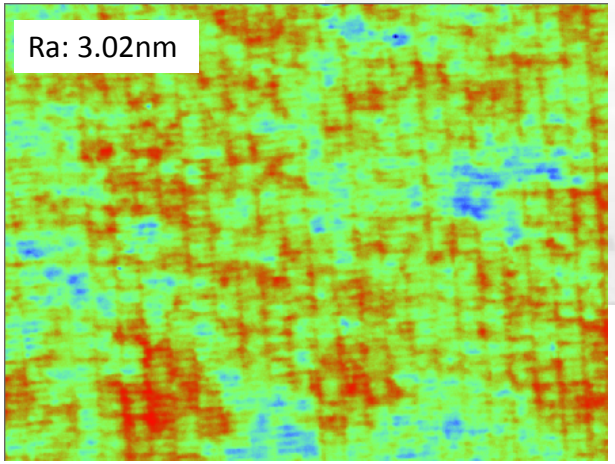
Content

Deep aspheric inserts for illumination optics

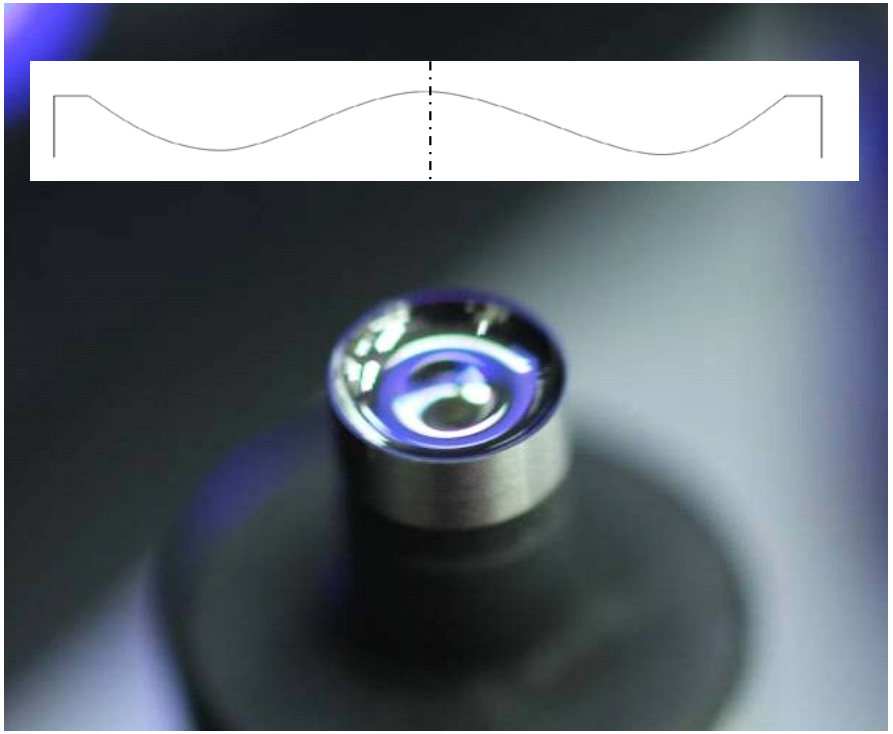
- Material: hardened steel 52 HRC
- Diameter: 30 mm
- Depth of cavity: 7 mm
- Surface quality Ra < 4 nm
- Form accuracy 200 nm



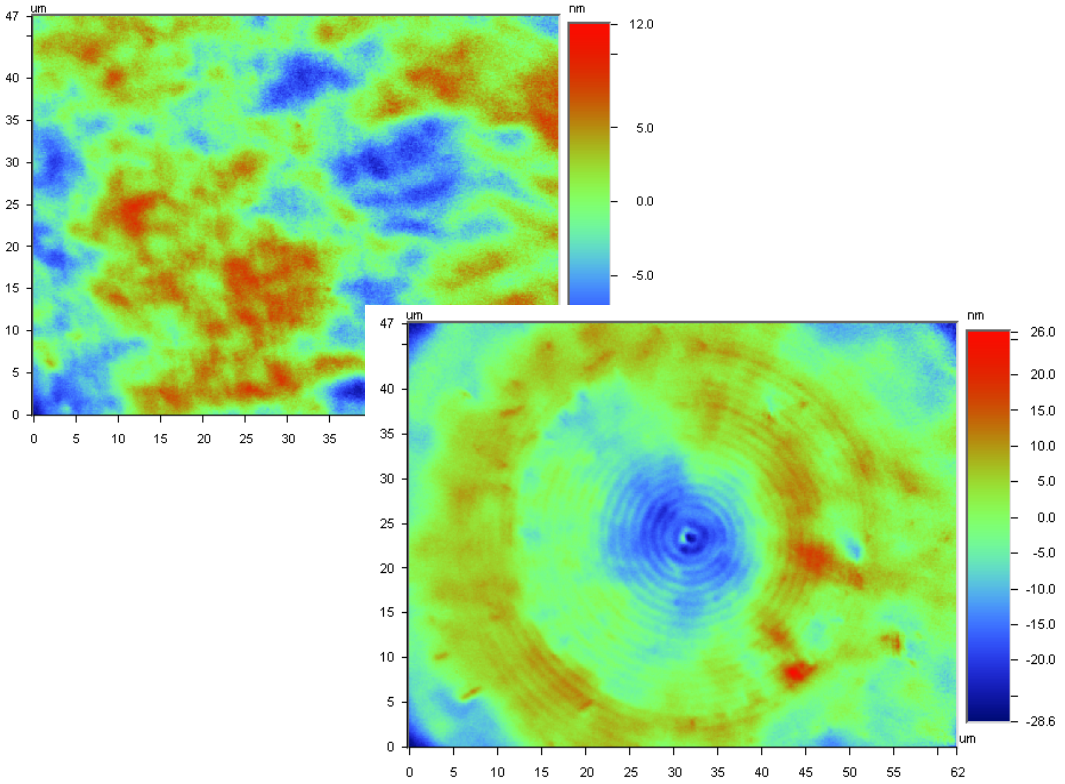


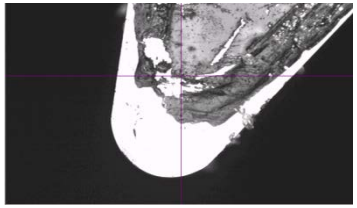


Steep aspheres – Imaging optics (mobile phone cameras)



- Steep asphere, max slope 60°,
- Diameter 5 mm, 54 HRC Steel
- Ra = 2.9 nm, Rt = 75 nm, PV < 250 nm



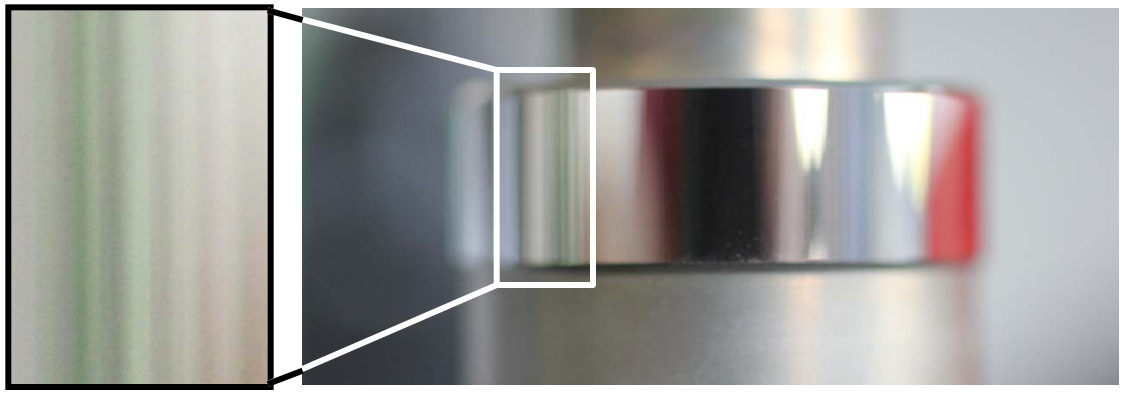


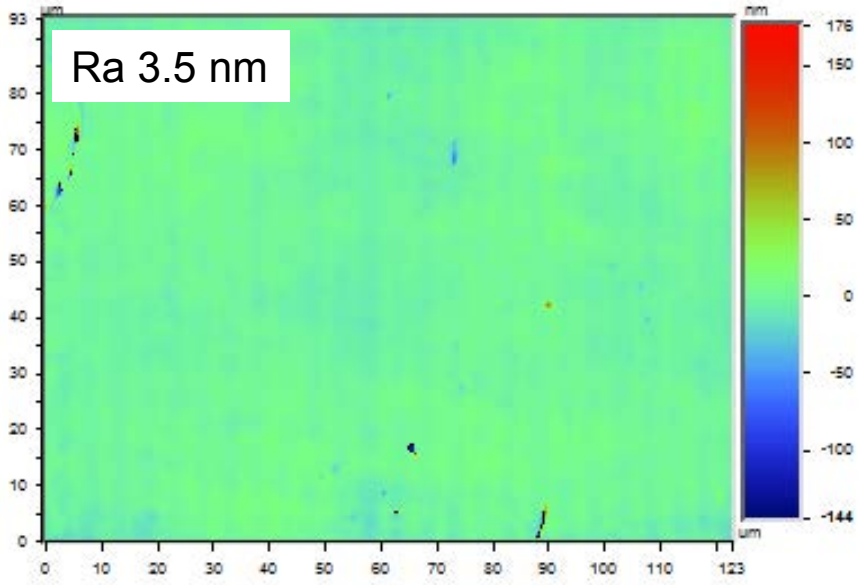
- Tool radius 0.08 mm
- No tool wear after machining

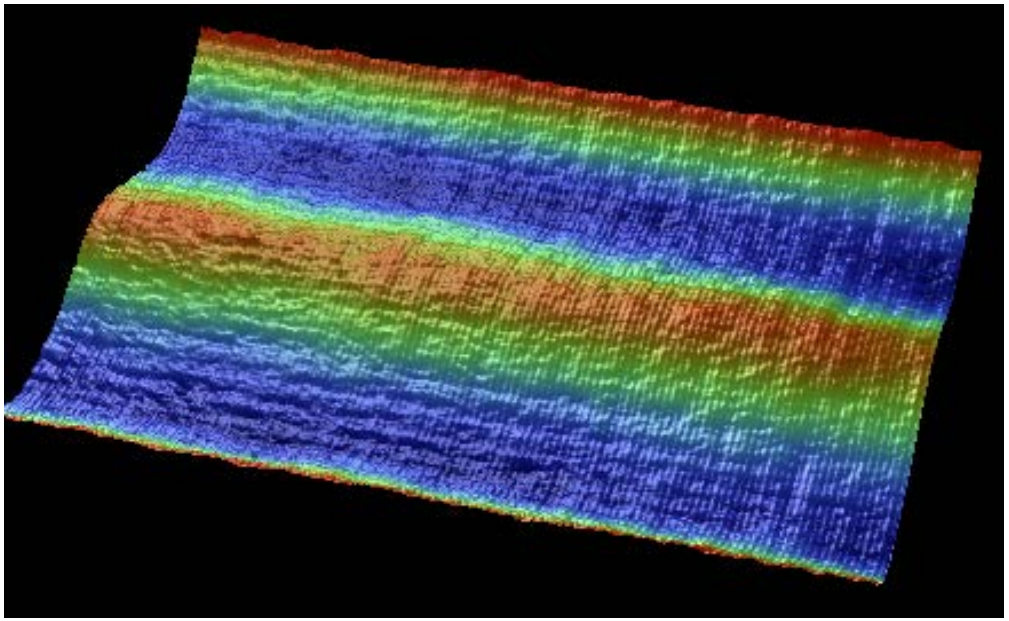
son x ultrasonic precision

Sine waves – Measurement standards

- Material: hardened steel 52 HRC
- Diameter: 45 mm
- Waves: height 200 nm
- 500 waves around surface
- Surface quality Ra~4nm



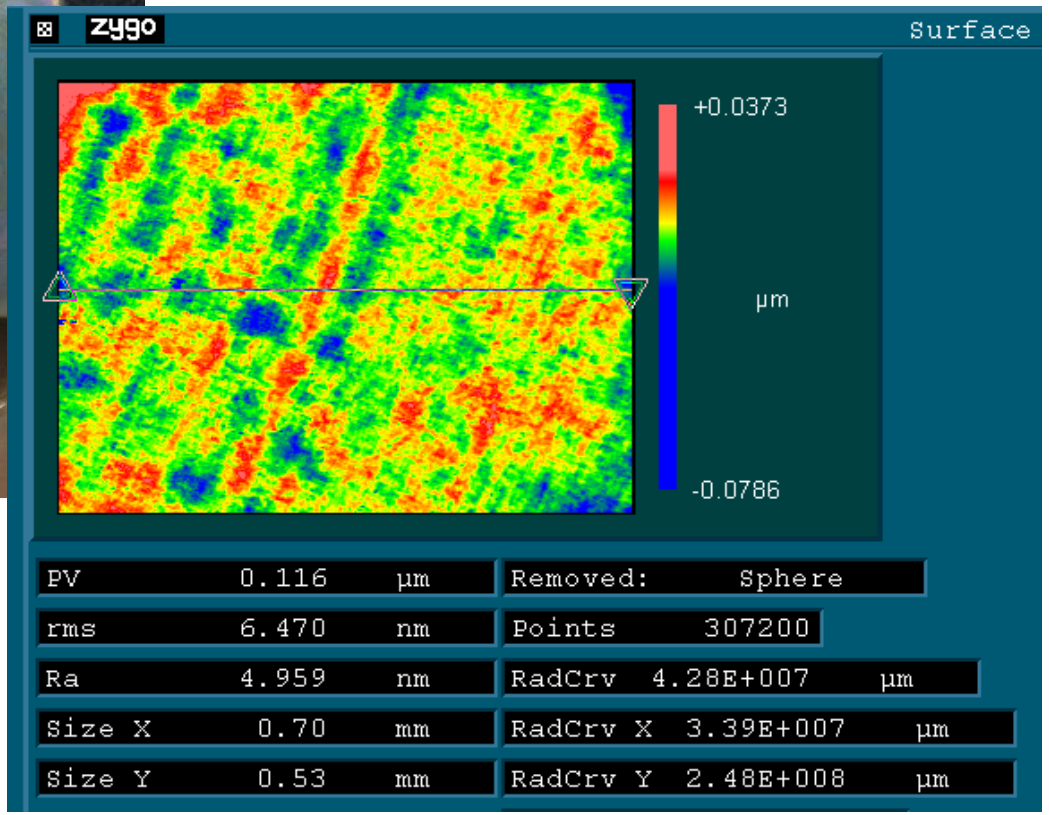




son x ultrasonic precision

Freeform inserts – Alvarez lens

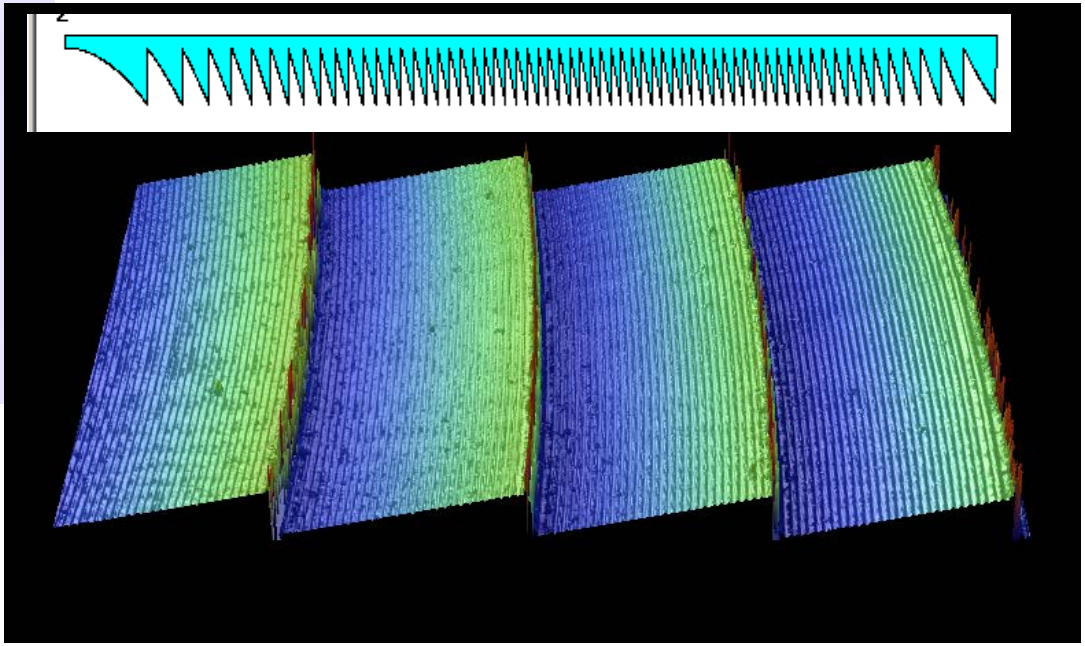
- Freeform,
- Diagonal ~50 mm, 52 HRC Steel
- Ra = 4.9 nm, Rt = 116 nm



son x ultrasonic precision

Diffractive structures – Infrared optics (moulded)

- Diffractive structure, height ~7 µm
- Diameter 25 mm, 54 HRC Steel
- Ra = 10 nm



son x ultrasonic precision

Micro lens array on aspheric inserts – Automotive Lighting

- Material: hardened steel 52 HRC
- Diameter: 12 mm
- Basic shape: aspheric
- Lens array with ~900 single lenslets
- Surface quality Ra ~ 5 nm
- Form accuracy PV < 500 nm

son x ultrasonic precision

Content

son x ultrasonic precision

Advantages of the technology and the mould inserts from son-x

Ultrasonic Tooling System UTS2

The Technology

- Direct diamond turning of steel
- No nickel plating
- Faster manufacturing


Aspheres


Micro Structures


Freeforms

The Mould Inserts

- Monolythic stainless steel inserts (no coating)
- Longer mould insert life (20%-100%)
- Faster manufacturing (1/2 of the lead time)
- Scratch resistant mould inserts
- Quick repairing

son x ultrasonic precision