Ultra-Precision Micromachining for Optical Applications

Machine basics:
- Microgantry® nanoSX manufactured by Kugler GmbH, Salem
- CNC-controlled 5-axes machining system
- air-bearing X- and Y-axes driven by ironless linear motors guarantee excellent positioning accuracies
- fine-grained granite machine base and gantry design result in a thermal and mechanical extremely solid setup and long-term machining capabilities with highest precision
- integration of tool (Blum LaserControl) and workpiece (Renishaw touch-trigger probe) measurement systems for the implementation of efficient compensation cycles

Integration of three machining modes
Air-bearing high-speed work spindle:
- for micromilling, -grinding and -drilling
- operates at up to 180,000 rpm
- spindle growth detection and compensation
- application of diamond tools for surfaces with \( R_a < 20 \) nm
- the use of a minimal lubrication system as well as a flooding machining equipment opens up a large variety of machinable substrate materials (steel, nonferric metals, polymers...)

High repetition rate picosecond laser:
- for laser ablation and polishing processes
- repetition rates of up to 600 kHz
- pulse duration < 10 ps
- wavelengths of 1064, 532 and 355 nm

Air-bearing flycutting-spindle
- for the fabrication of plane, spherical and aspherical optical components with highest surface accuracies \( R_a < 10 \) nm by diamond metal-cutting in nonferric metals and polymers

Applications:
Fabrication of optical components like
- freeform surfaces for aberration correction elements
- metal optics (mirrors, gratings)
- master moulds for replication processes
- integrated systems with microopto mechanical and/or fluidic functionalities (MOEMS)
Integration platform for gas sensors based on nanowire heterostructures

50 mm
phase plate for a tunable Alvarez-Lohman phase lens

50 mm
freeform elements

10 mm
replicated optofluidic systems

50 mm
integrated fluorescence detector

10 mm
integrated beam shaping