

A high-precision large area spiral scanning AFM

Background

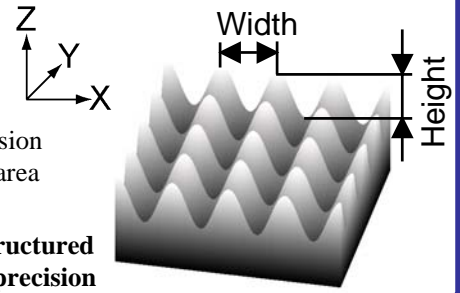
3D microstructured surfaces were widely applied in quite many micro-optics products

Examples: Micro-lens, Metrology surfaces etc.
 Shape: Width (XY): several μm – several hundred μm
 Height (Z): sub-micron – several tens μm

Request of high-precision fabrication and large area fabrication

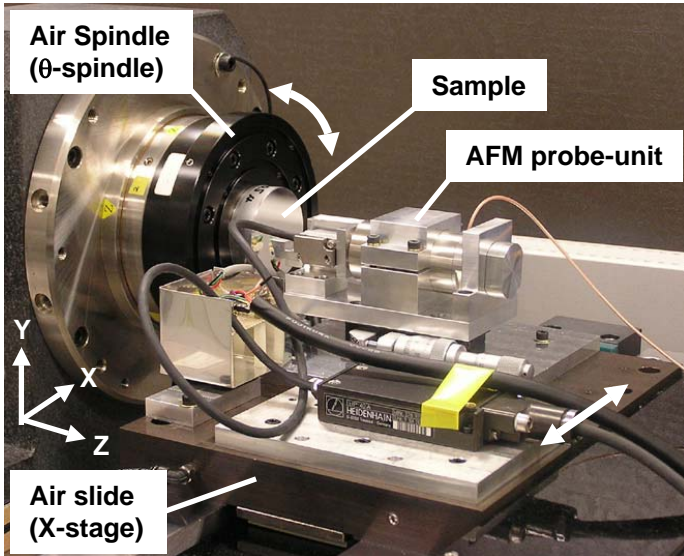
Optical microscopes and scanning electron microscopes are not proper.

➔ **Nanometrology of large area 3D microstructured surface profiles is an important task for precision fabrication of the surface.**



Measurement System

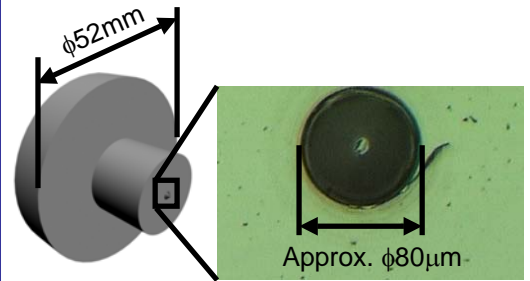
Adopt spiral scanning method which is of advantage for large area and high speed measurement



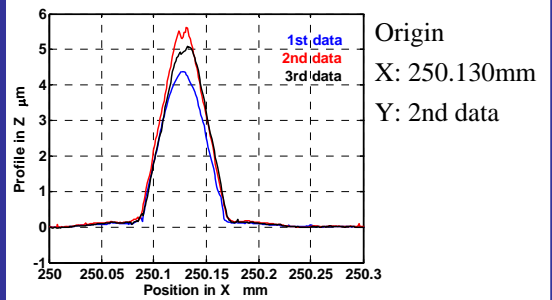
A problem that scanning positioning resolution in the circumferential direction go down in outer part

➔ Adopt a high resolution spindle with 0.009 arcsec

Centering



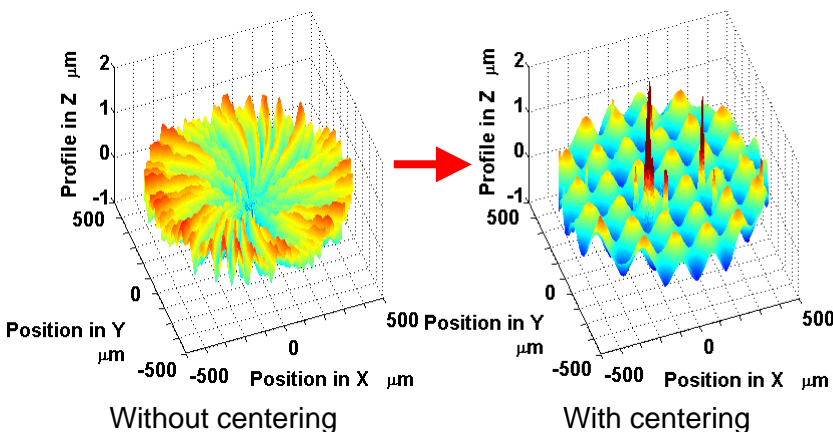
Centering artifact



Align the center of measurement coordinate system with the rotation center of the spindle using the artifact

Measured Profile of a 3D Microstructured Surface

Sinusoidal metrology surface Amplitude: $A=1\mu\text{m}$ Wavelength: $\lambda=150\mu\text{m}$ (Design value)



Result (Mean value & dispersion)

Amplitude: $0.943\mu\text{m} \pm 0.138\mu\text{m}$ (3σ)

Wavelength: $155.769\mu\text{m} \pm 39.172\mu\text{m}$ (3σ)

- Realized spiral scanning measurement
- Centering is important for r θ coordinate measurement.