

Micro- and Nano-Technology... **... for Optics**

4. Characterization Techniques

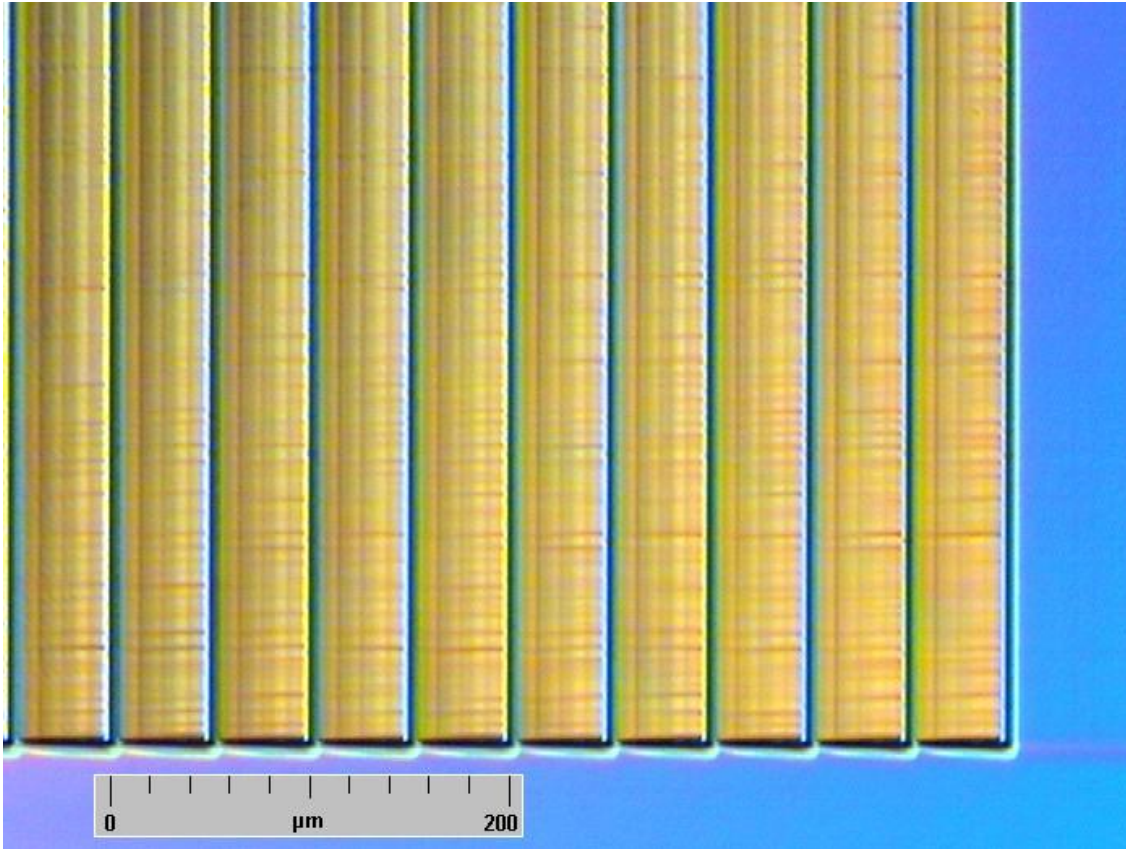
U.D. Zeitner

Fraunhofer Institut für Angewandte Optik und Feinmechanik
Jena



Microscope

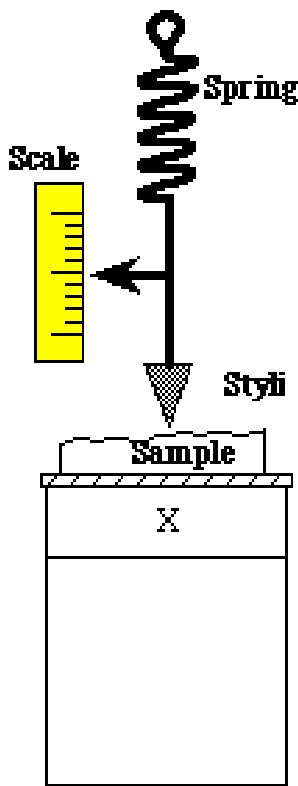
Microscope image of a blazed grating



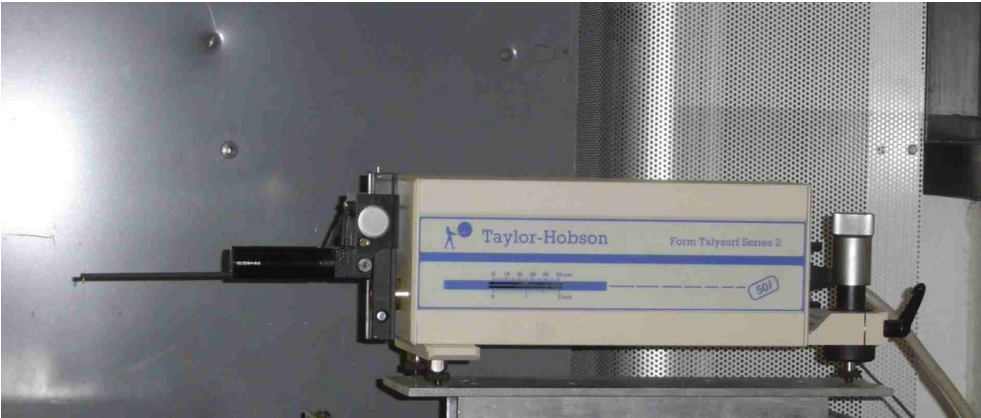
→ no information about profile

Mechanical Surface Profiler

(Stylus Profiler)

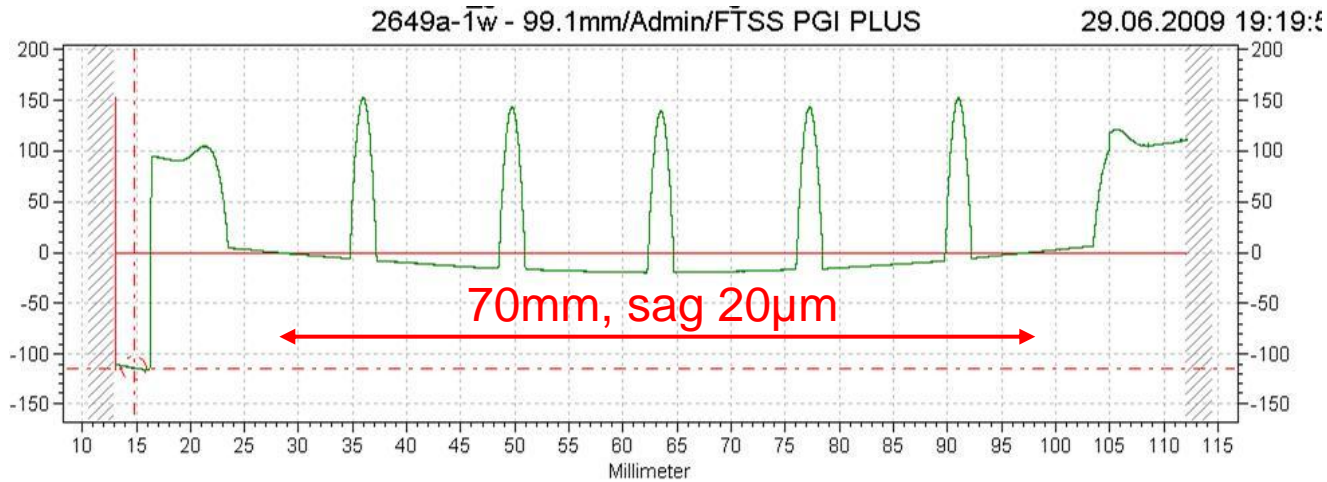


Idea of Stylus profilometer



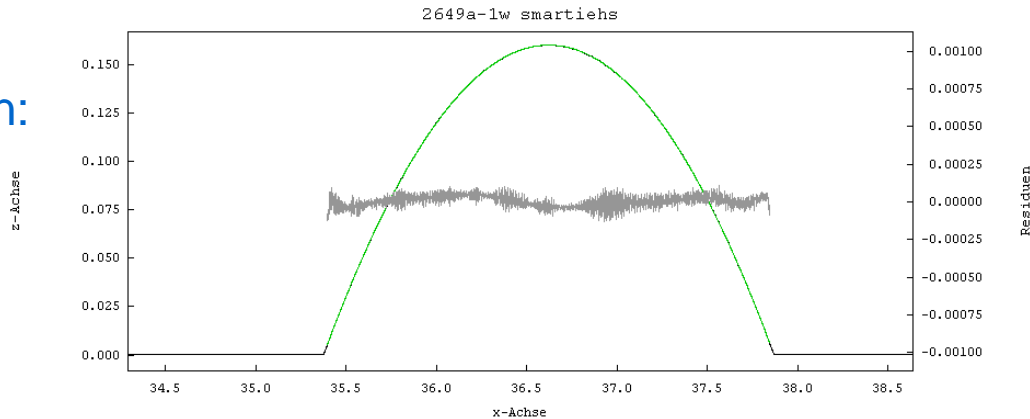
Mechanical Surface Profiler – Examples

Micro-Lens Profile across wafer, B33 glass 0.7mm thick



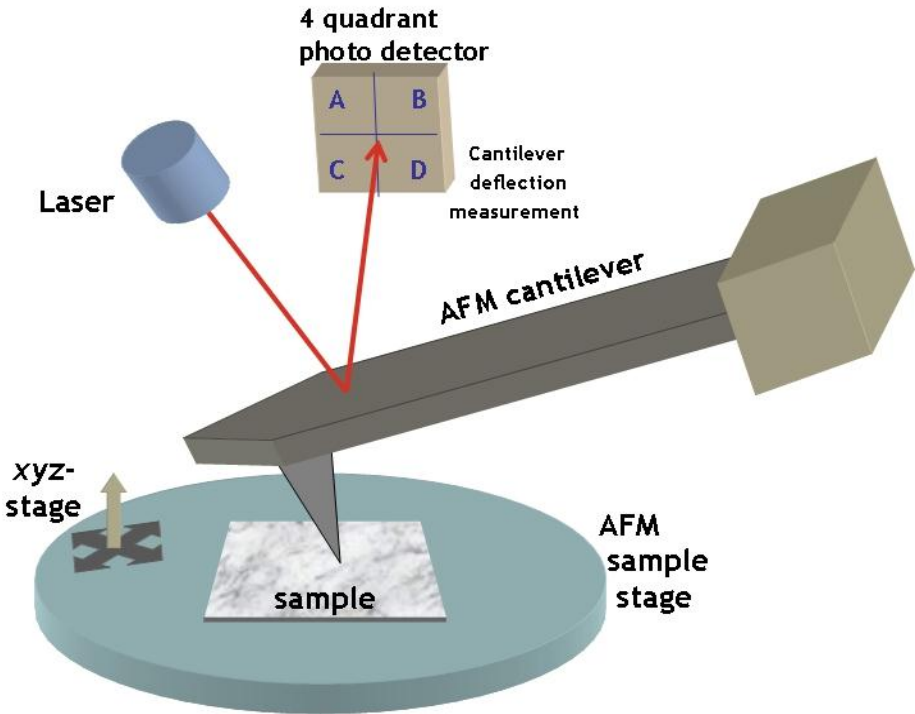
polymer:
120µm base
+160µm lens

Form
deviation:



$R=4.81\text{mm}$
 $k= -1.8$

Atomic Force Microscope – AFM



Cantilevers:

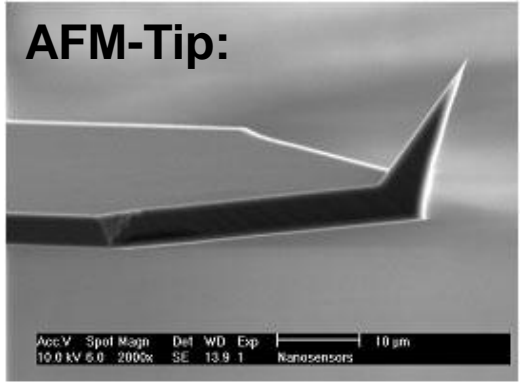
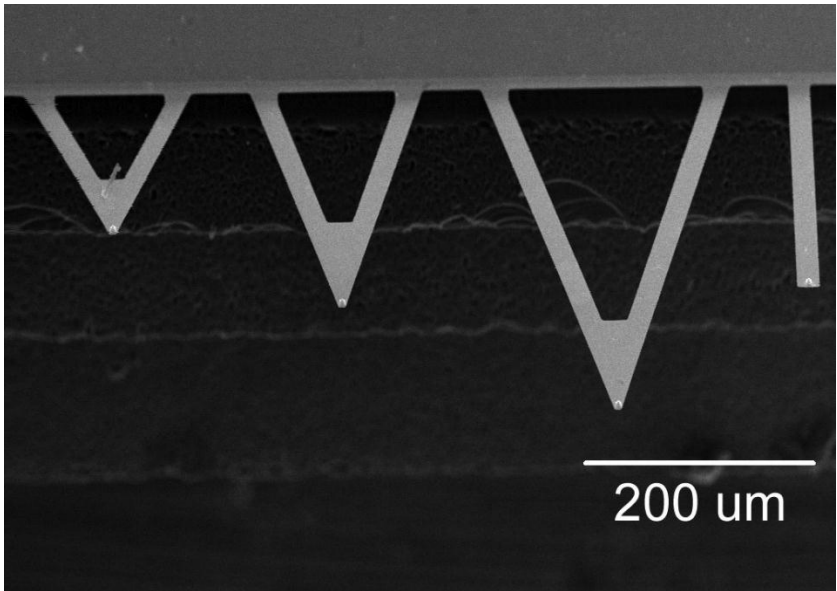
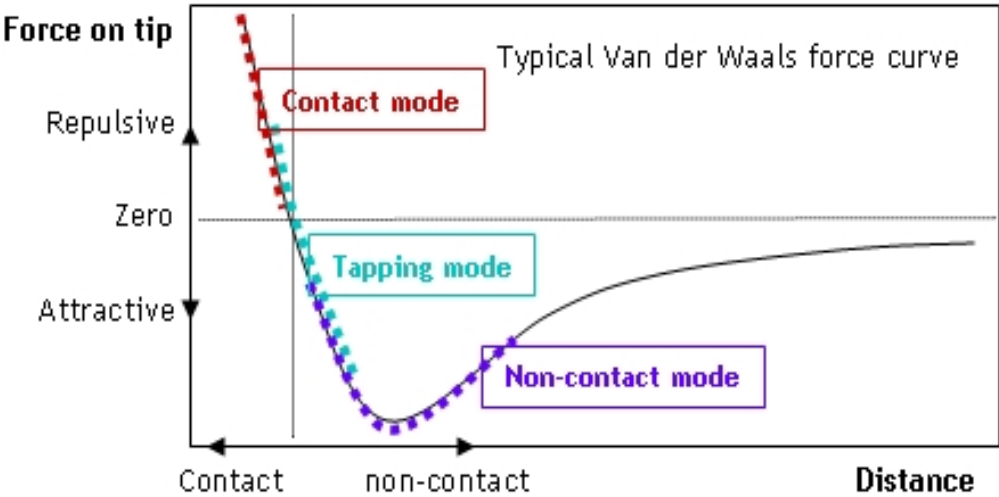
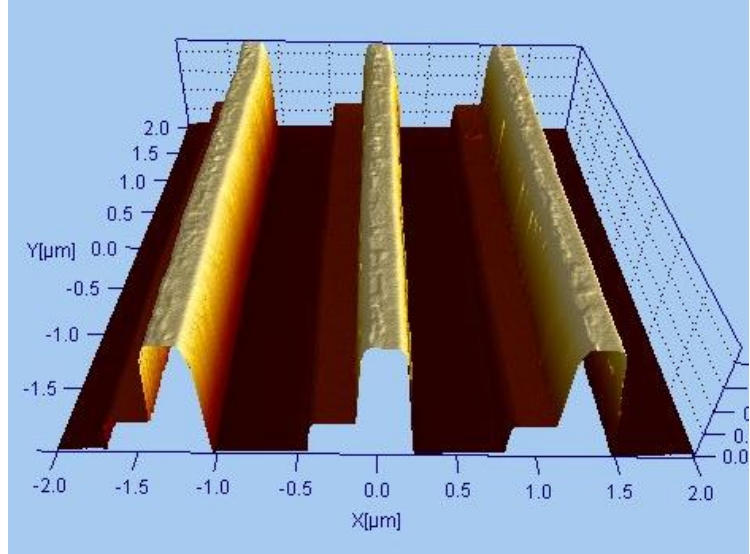


Fig.: NANOSENSORS™ AdvancedTEC™ AFM tip

Atomic Force Microscope – AFM



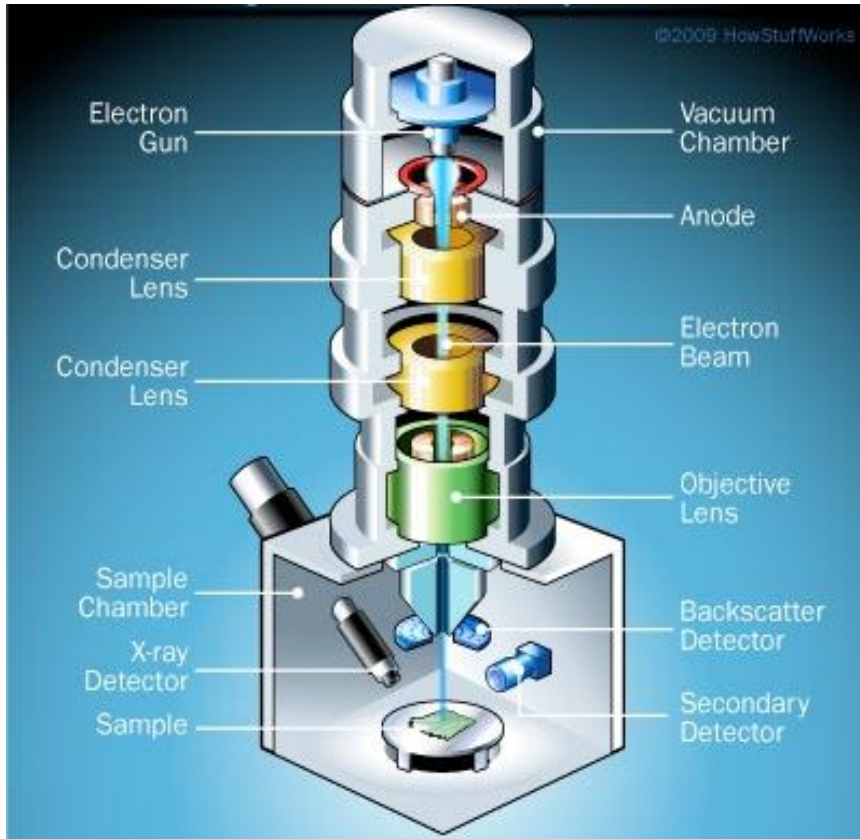
Example Measurement:



3-level grating

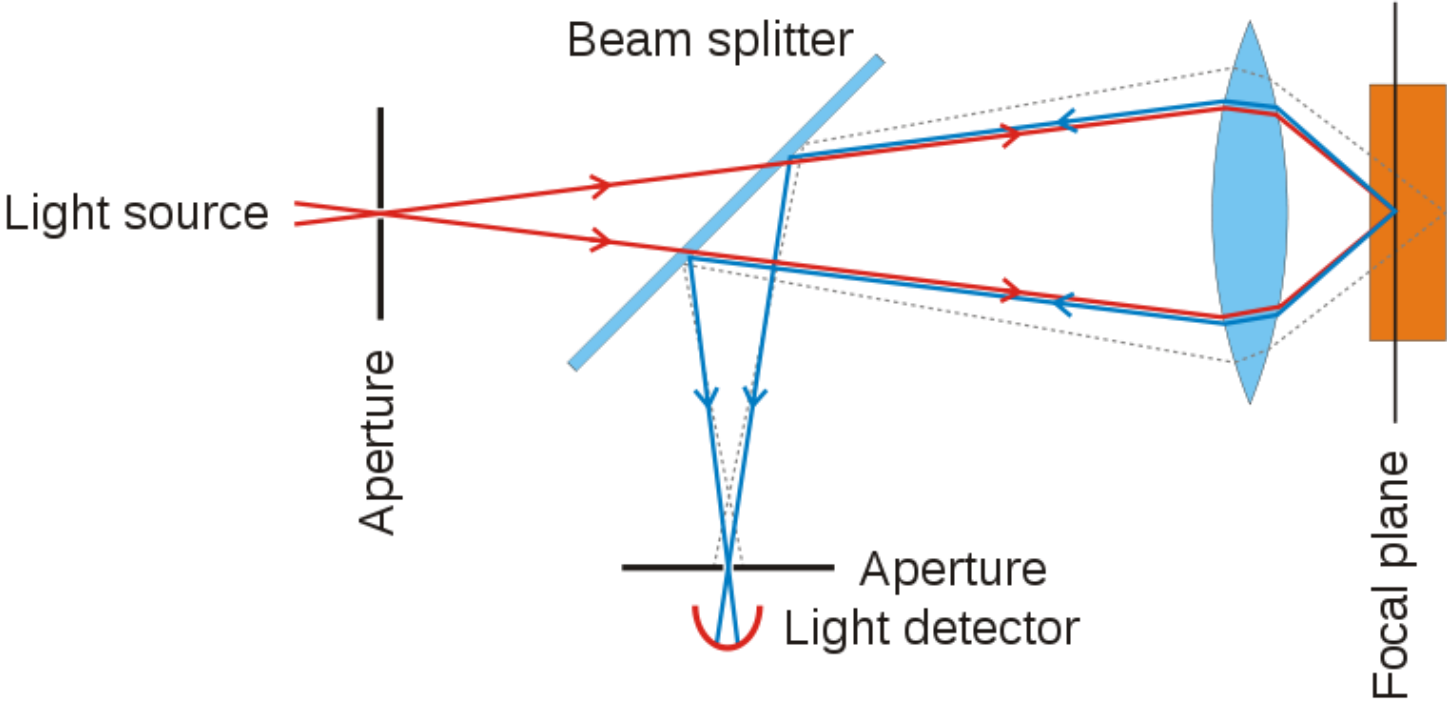
Scanning Electron Microscope – SEM

Hitachi S-3400

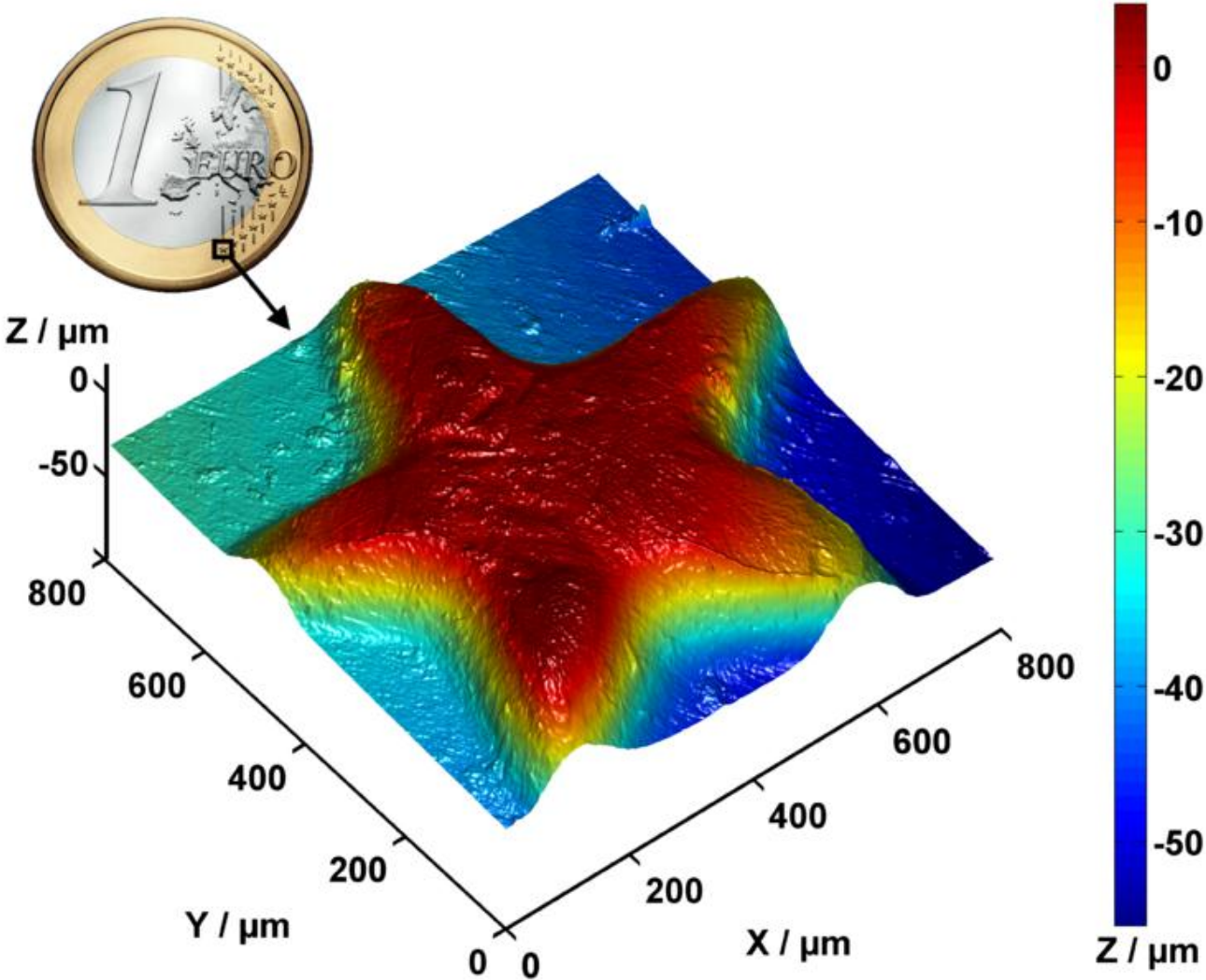


Accelerating Voltage: 0.3 ... 30keV
Resolution (SE): 3.0nm (30keV)
10.0nm (0.3keV)
Magnification: 5x ... 300.000x

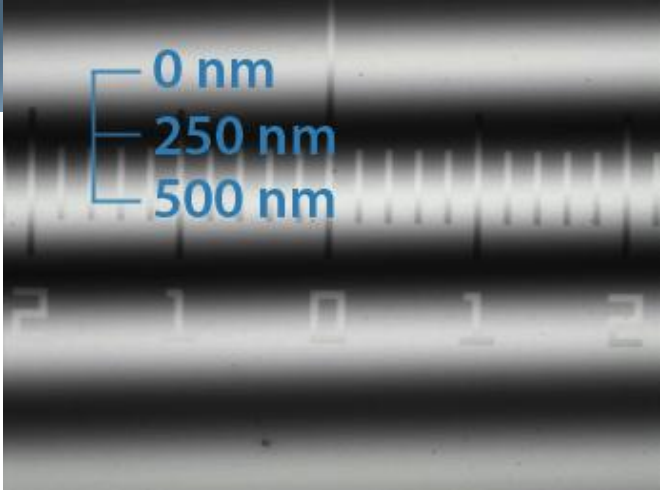
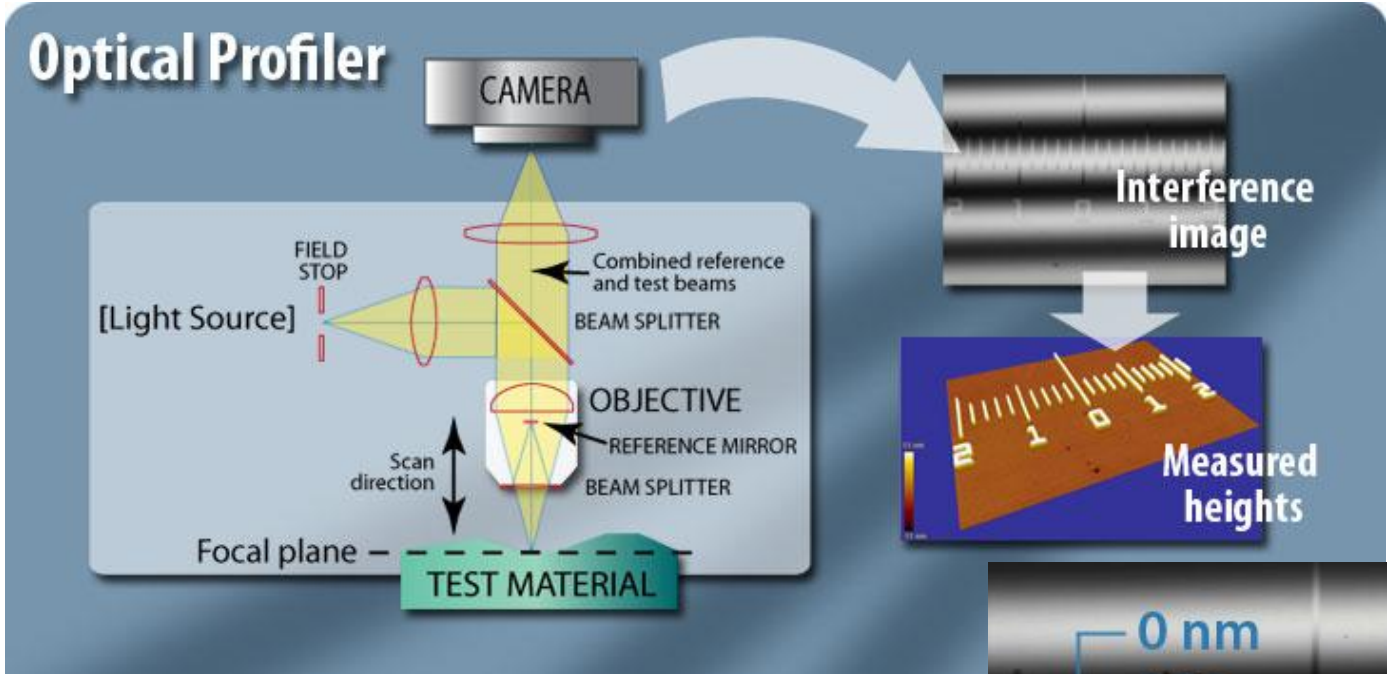
Confocal Microscope



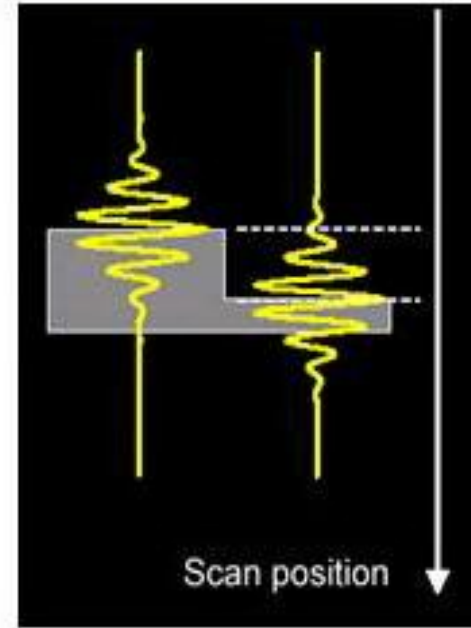
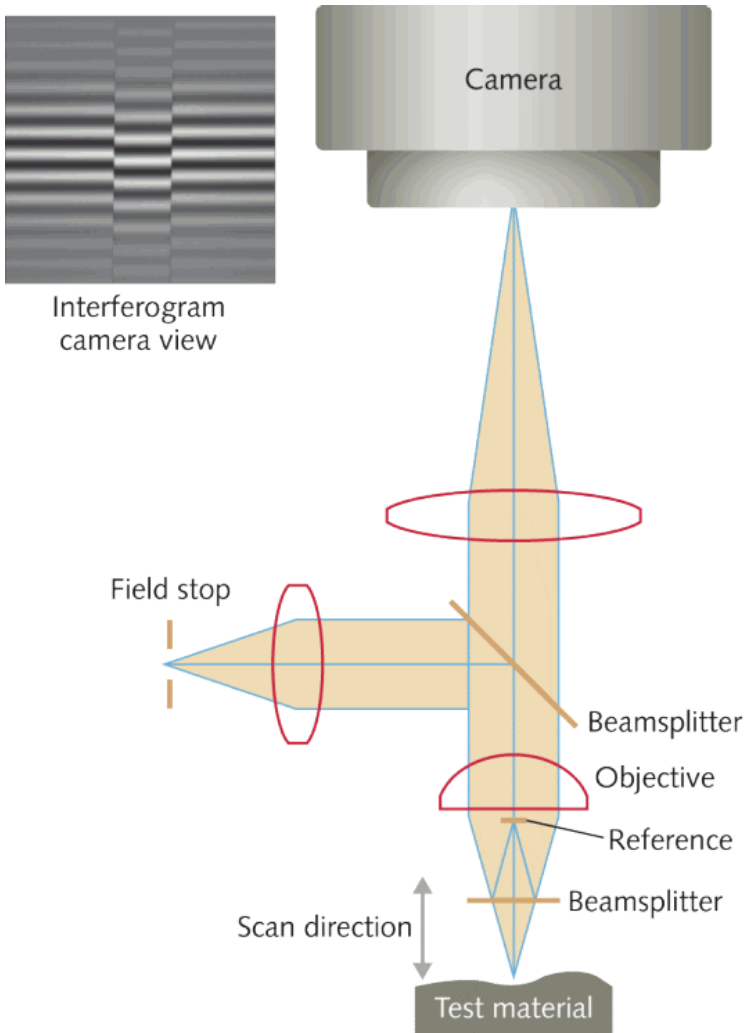
Confocal Microscope – Example



Interference Optical Surface Profiler



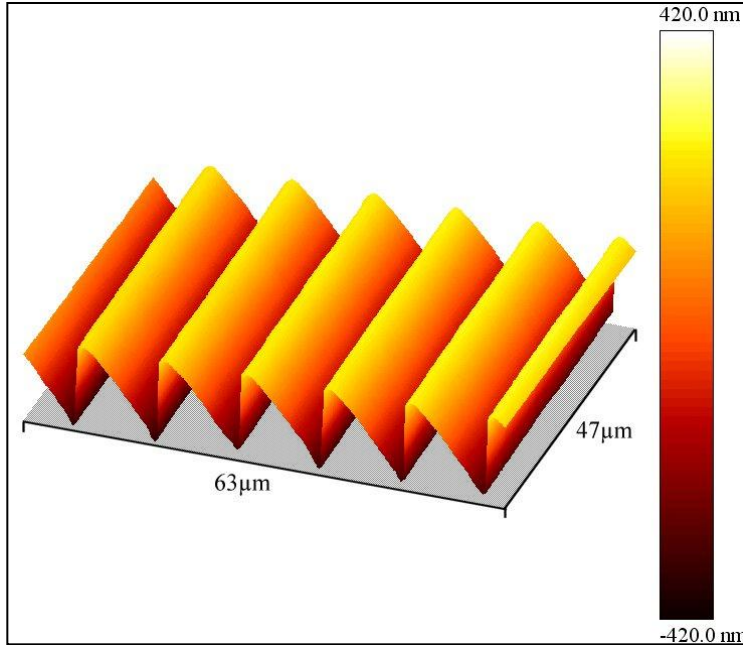
Interference Optical Surface Profiler



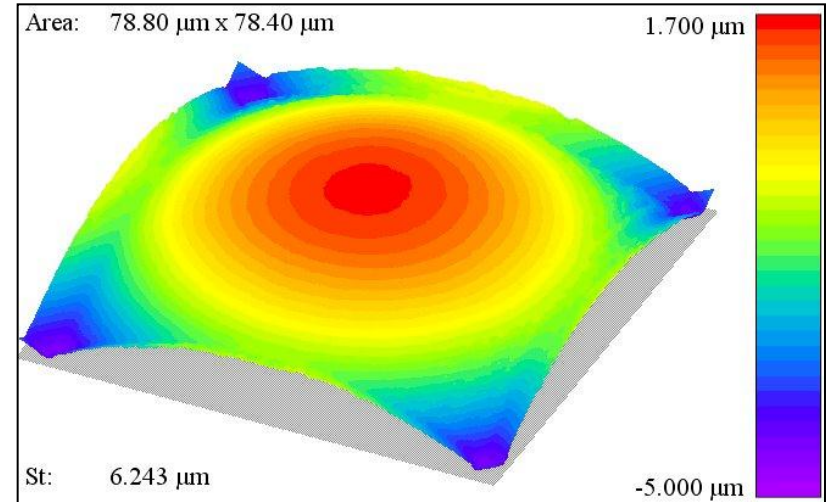
Limited coherence length of light source
→ interference contrast only where lengths of measurement and reference arm are equal
→ z-scan of sample for detecting larger profile depths

Interference Optical Surface Profiler

Example Measurements



measurement of blazed grating profile
sag: 820nm
grating period: 10 μm



measurement of lenslet profile
sag: 7.7 μm
profile error: PV < 150nm