

Equipment list:

Description	Supplier	Model
Optical test bench	Optikos	LensCheck VIS
Optical test bench	Trioptics	OptiSpheric
		OptiSurf
		OptiCentric
Point source microscope	Optical Perspectives Group	
Interferometer	Zygo	Mark GPI-XPS
Transmission spheres	Zygo	4" F/0.75
		4" F/7.1
Interferometer	ESDI	Intellium H2000
Transmission spheres	ESDI	4" F/1.5
		4" F/3.3
		4" F/11
Interferometer calibration device	ESDI	CaliBall
Attenuation filter	ESDI	AF100-M
Inspection microscope	Olympus	STM6
Optical profilometer		
Stylus contact profilometer	Veeco	Dektak 150

Equipment details:

Optical test bench – Optikos LensCheck VIS



Measurement of MTF (on/off axis), EFL, F/#, BFL, astigmatism, field curvature and distortion.

MTF measurement accuracy: 2%

MTF measurement repeatability: 1%

Motorized lens platform: +/- 100 degree off-axis rotation

0.0001° resolution glass scale encoder

Optical test bench – Trioptics OptiSpheric



Measurement of standard lens and IOL parameters, EFL, BFL, FFL, radius, centering, MTF and diopter power.

EFL resolution: 0.03 to 0.2%

EFL Measurement accuracy:

5 to 25 mm: 0.1% to 0.3%,

25 to 500 mm: 0.03% to 0.1%

500 to 1000 mm: 0.05% to 0.3%

MTF measurement repeatability: 1%

MTF measurement accuracy: 2%

BFL, FFL, and radius of curvature repeatability: 0.02 to 0.2%

BFL, FFL, and radius of curvature accuracy: 0.03 to 0.3%

Optical test bench – Trioptics OptiSurf

Non-contact thickness and distance measurement within lenses and optical systems.

Measurement accuracy: 1 μm over measuring range

Scanning range: 800 mm optical distance

OptiSurf Professional software

Optical test bench – Trioptics OptiCentric

Centering error measurement, assembling, automated cementing and bonding of lenses, optics and optical assemblies.

Centering accuracy: < 0.1 arcmin (tilt), $< 2 \mu\text{m}$ (decenter)

Machining tolerances: $< 2 \mu\text{m}$

Flatness of plano surfaces: $< 1 \mu\text{m}$

Cylindricity of lens cell: $< 1 \mu\text{m}$.

Point source microscope – Optical Perspectives Group



The Point Source Microscope (PSM) is used for optical system alignment. The instrument can perfectly align each optical component's center-of-curvature and position on its on-axis focused beam, exactly to specifications.

The PSM is also used for aligning aspheric optics, including off-axis aspheres. The PSM locates point images and shows the image shape as a star test. The PSM enables adjusting the asphere to reduce alignment error to near zero by keeping the image in the correct location while adjusting the asphere to minimize aberrations.

Lateral sensitivity: ± 0.5 mm range, $0.1 \mu\text{m}$ sensitivity with 10X objective

Axial sensitivity: $\pm 2 \mu\text{m}$ with 10x objective

Angular sensitivity: $\pm 1.4^\circ$ range, ± 1 arcsecond sensitivity when used as an autocollimator (no objective)

Interferometer – Zygo Mark GPI-XPS



Phase-shifting interferometer with digital camera providing 640×480 image acquisition.

4 inches test beam

1X to 6X zoom

Uses industry-standard 100 mm bayonet reference optics

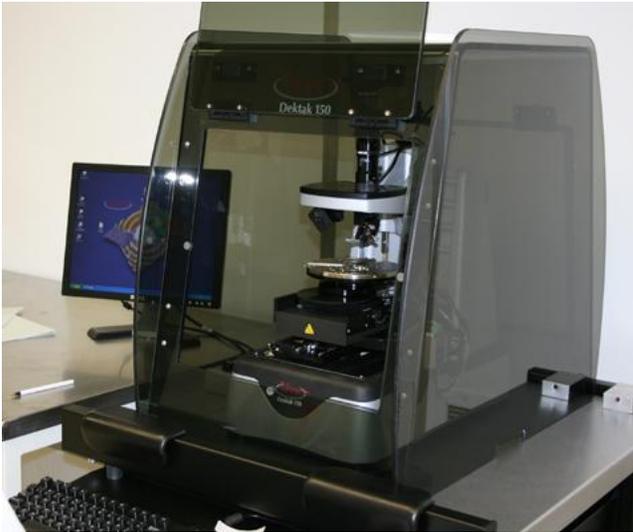
ZYGO MetroPro 8.3.5 software running under Microsoft® Windows XP Professional

Interferometer - ESDI Intellium H2000



$\lambda/100$ P-V measurement error with no vibration isolation
Common-path Fizeau interferometry
4 inches test beam
Measurement speed as fast as 10 μ s
Measure surfaces with 0.1% to 100% reflectivity
1X to 6X zoom
Uses industry-standard 100 mm bayonet reference optics
Total vibration insensitivity
ESDI IntelliWave software

Stylus contact profilometer - Dektak 150



Advanced thin and thick film step height measurement tool.

Can be used to profile surface topography and waviness, as well as roughness at the nanometer scale.

Step measurement: < 1 nm

Sample diameter: up to 200 mm and up to 90 mm thick

Repeatability: 0.6 nm

Inspection microscope – Olympus STM6



UIS2 Optical System (Infinity-corrected)

Motorized/manual focus (Manual 2-axis/3-axis type, Motorized 3-axis type)

Stroke: 155 mm

Coarse focusing speed: 4.8 mm/sec

Fine focusing speed (variable): 800 um/400 um/200 um/50 um (full rotation of knob)

SEM/FIB microscope FEI model Quanta 3D FEG



Scanning electron (SEM) and focused ion beam (FIB) microscope. The Quanta 3D FEG is the most versatile high-resolution, low vacuum SEM/FIB for 2D and 3D material characterization and analysis in the nanometer range. The FIB module can also be used to mill non-conductive samples in order to characterise the cross-section of a multilayer sample.

Veeco Dimension V Scanning Probe Microscope



Atomic Force Microscopy (AFM) provides the ability to image the surface topography of both conducting and insulating samples, as well as adsorbed molecules and nanoparticles.

Leybold SYRUS-PRO-710 Advance Plasma System (APS)



Plasma ion assisted deposition

Materials: Ti₃O₅, TiO₂, SiO₂, HfO₂, Ta₂O₅, Al₂O₃, ZrO₂, SnO₂, ITO, MgO/Ti₃O₅,
TiO₂, SiO₂, HfO₂, Ta₂O₅, Al₂O₃, ZrO₂, SnO₂, ITO, MgO

Maximum substrate size: 4 inches in diameter

Intlvac Nanochrome System



DC sputtering deposition

Materials: Si, Al, Nb, W, V, T, Ta

Maximum substrate size: 8 inches in diameter

Thermal Evaporator (Homemade)



Materials: Al, Cu, Ag, Cr
Maximum substrate size: 10 inch in diameter

Electron Beam Physical Vapor Deposition or EBPVD



4 pockets of 7 cubic centimeter to evaporate 4 different materials
Materials: MgF₂, ZnS, YF₂, YbF₃, SiO₂
Maximum substrate size: 4 inch in diameter

These thin film deposition systems can produce anti-reflective, low-pass, bandpass coatings as well as Fabry-Pérot filters, metallic and dielectrics mirrors and transparent electrodes (ITO).

Thin Films design software

TFcalc (<http://www.sspectra.com/>)

MCalc Multilayer Calculation 4.0

Metricon prism coupler mline model 2010/M



It uses optical waveguiding techniques to rapidly and accurately measure both the thickness and the refractive index/birefringence of dielectric and polymer films as well as refractive index of bulk materials. Operating at wavelengths 532, 633, 972, 1038 and 1538 nm.

Index accuracy: ± 0.0005 (accuracy of up to ± 0.0001 available for many applications)

Index resolution: ± 0.0003 (resolution of up to ± 0.00005 available for many applications)

Thickness accuracy: $\pm(0.5\% + 5 \text{ nm})$

Thickness resolution: $\pm 0.3\%$

high accuracy index measurement of bulk, substrate, or liquid materials including birefringence/anisotropy

simple measurement of index vs wavelength

options to measure index vs temperature (dn/dT), and waveguide loss

wide index measurement range (1.0-3.35)

Horiba-Jobin-Yvon Uvisel/460 Spectroscopic Ellipsometer



Ellipsometry measures a change in polarization as light reflects or transmits from a material structure. Ellipsometry is primarily used to determine film thickness and optical constants. However, it is also applied to characterize composition, crystallinity, roughness, doping concentration, and other material properties associated with a change in optical response.

Spectral range: 260-1700 nm

Spectrometer Agilent technologies model cary 5000 UV-VIS-NIR



The Cary 5000 is a high performance UV-Vis-NIR spectrophotometer with superb photometric performance in the 175-3300 nm range. It measures beyond 8.0 absorbance units with reference beam attenuation using Schwarzschild coupling optics for higher accuracy at low transmission levels ensuring Maximum light throughput.

Spectrometer Stellarnet inc green-wave model GW-Vis



The SpectraWiz software is included to accurately measure wavelength emissions, reflectance, transmission, absorption, concentrations, and absolute intensities.
Visible wavelength range (350-1150)
With integrating sphere (IC-2)