

NanoSpec 6500



The NanoSpec 6500 utilizes an advanced spectroscopic reflectometer to measure optically transparent films that are used in the manufacture of thin film on glass for displays and other applications. Designed for maximum throughput, reliability and accuracy, the NanoSpec measures all transparent or translucent multi-stack films on virtually any kind of substrate. Capable of handling all sizes from “tablet” size glass to G10 panels almost three (3) meters square, the 6500 is specifically designed for a wide variety of production applications. The rugged system provides

precise measurements of single-layer films such as oxide, nitride and photo-resist, as well as the top layer on film stacks of up to 3 layers in the thickness range of 100Å to 35µm and features an optional 0.75µm spot for small areas. Proprietary software enables Multilayer Film Analysis with the ability to select film constants, scan ranges and substrate types, the 6500 is the ideal tool for rapid process control measurements at the production level.

Product enhancements include the integration of ultra-violet (UV) spectroscopic reflectometry for the measurement of low temperature, deposited poly-silicon films and UV to near infra-red (NIR) as well as spectroscopic ellipsometry (SE) for the measurement of multilayer film stacks and improved measurement precision.

Data management features include a database, statistical analysis, histograms and the ability to and export data files. Both Tabular and Cauchy dispersion models are available for use and material files may be imported and exported.

Features

Standard Features

- Comprehensive Measurements

The 6500 provides scanning from 400 to 800 nm and can measure single layer films such as oxide, nitride and photo-resist, as well as multiple layer film stacks when XMP software is utilized. Measurements can also be made on a wide variety of other substrates including silicon, aluminum and gallium arsenide.

- Highly Configurable

The 6500 is highly configurable. Small spot size measurements can be performed with an optional 100x lens. With the 6500T model, film layers as thick as 70 µm are measurable with an installed small-aperture system. Consult the optional features list for a full listing of options available to the NanoSpec 6500.

- Dynamic Software

The advanced software platform provides the process engineer with complete freedom and flexibility in creating custom measurement programs to meet the demanding needs of today’s new micro-electronic Mass Production facilities. Data management features statistical analysis, histograms and

the ability to import and export data files are all standard. Both tabular and Cauchy dispersion models are available for use and material files may be imported and exported.

Standard

- 6500 base unit includes 5x, 10x, 50x objectives
- XMP Film Analysis Software for Multi-layer instant measurements (Extended Material Package)
- Auto Focus capabilities
- Vibration Control
- UPS Backup system
- Windows based operating system
- Onboard 10/100 LAN
- 17" flat panel display
- Operations manual (CD)

Options & Accessories

- ESD Suppression Stage
- Advanced Particle Prevention system
- Automated Robotic L/UL
- Pattern Recognition
- Transmittance for Optical Density and Chromaticity
- FTIR for Hydrogen Content
- Sheet Resistivity Module (4PP)
- Signal Tower
- Ionizer
- Contact Angle Module
- Small aperture system for thick film measurement
- Small spot with 100x objective – 0.75 μm
- SECS, RS-232 or HSMS
- Color video camera with dedicated 17" flat panel display
- CIM Control
- HSMS or SECS interface
- CD-RW drive
- Clean-room operations manual (hard copy)
- NanoStandard film thickness standard wafer (6- or 8-inch)¹

Notes:

1 NanoStandard® wafers are NIST traceable film thickness standards consisting of six pads of different oxide thicknesses on silicon.

Specification

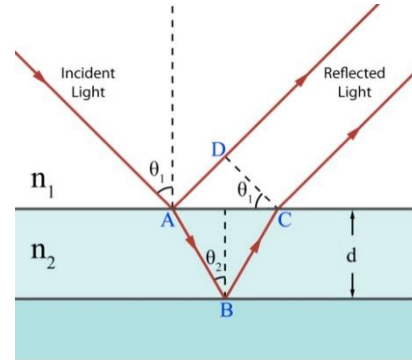
Utilized at all major Flat Panel Display fabs worldwide, the NanoSpec 6500 has been engineered to provide outstanding film thickness measurements. Widely respected as the leader among film analysis production systems, leading specifications and performance place the NanoSpec 6500 at the top of its class. Specifications are listed below.

NanoSpec 6500 <i>Film Thickness</i>	Specification	Flat Panel
Performance		
Film Stack / Number of Films	Up to 3 layers	
Wavelength Range	400 -800 nm	
Optional Transmittance Measurement	400 -800 nm	
Film Thickness Thickness Range ¹		
Standard Configuration (10x)	100 Å - 30 µm	
Range: single stack	10 nm ~ 35 µm ¹	
Repeatability	1.0% or 2 Å ²	
Film Type / n & k values	obtained	
Measurement Time	0.5 seconds per point (film dependant)	
Data Management	Statistical data analysis, Data export (ASCII)	
Hardware Configuration		
Panel Sizes	300 ~ 3200 mm	
Head Unit	Interferometer / Reflectometer Linear Array	
Optics / Spot Sizes		
5x (standard)	50 µm	
10 x (standard)	25 µm	
50x (standard)	5 µm	
100 x (optional for Thick film)	0.75 µm	
Optical Filters (Manual Cutoff Filters)		
Yellow cutoff filter	480 nm (measured at 50% light transmission)	
Orange cutoff filter	560 nm (measured at 50% light transmission)	
Light Source	Halogen	
Computer	Intel Core2Duo/2.8 GHz or later	
Facilities Requirements		
Dimensions	1700mm x 1700mm x 1830	
Weight	2200 Kg	
Electrical	Single Phase AC 200V 50/60Hz, 10A 230V, 50/60 Hz, 2.5 A	
Vacuum	-55 to 80 KPa	
Notes:		
¹ value obtained from SiO ₂ /Si		
² 1 sigma based on measuring same site 15 times with 10X w/out autofocus after autofocus on first measurement.		
standard sample with interference amplitude reflectance is greater than 5% of absolute reflectance		

Theory

The TohoSpec 6500 employs non-destructive, optical thin film measurement which analyzes the light-interference caused by thin layers. The reflection at the layer surface and layer-substrate interface results in constructive and destructive interference depending on the wavelength of the light.

As light strikes the surface of a film it is either transmitted or reflected at the upper surface. Light that is transmitted reaches the bottom surface and may once again be transmitted or reflected. The Fresnel equations provide a quantitative description of how much of the light will be transmitted or reflected at an interface. The light reflected from the upper and lower surfaces will interfere. The degree of constructive or destructive interference between the two light waves is dependent upon the difference in their phase. This difference is dependent upon the thickness of the film layer, the refractive index of the film, and the angle of incidence of the original wave on the film. Additionally, a phase shift of 180° or π radians may be introduced upon reflection at a boundary depending on the refractive indices of the materials on either side of the boundary. This phase shift occurs if the refractive index of the medium the light is travelling through is less than the refractive index of the material it is striking. In other words, if $n_1 < n_2$ and the light is travelling from material 1 to material 2, then a phase shift will occur upon reflection. The pattern of light that results from this interference can appear either as light and dark bands or as colorful bands depending upon the source of the incident light. This basic theory is applied to the NanoSpec 6500.



As the layer thickness cannot be calculated out of these reflection spectra directly, a special best-fit algorithm is used to determine the layer thickness. In this way not only single layers but also multi-layer stacks with known optical data (n, k) can be measured easily and very fast.

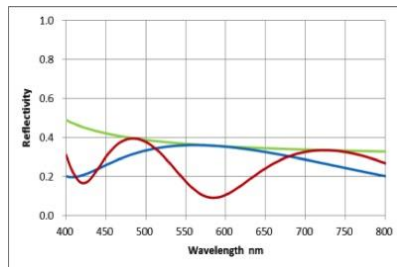
The NanoSpec 6500 is most effective when these criteria are fully met.

1. A difference in the refractive index of the layers and the substrate must be present to get any reflection at the interface.
2. The layers must be transparent or semi-transparent in the spectral range in order to let the light through.
3. The substrate and the layer surface must be smooth enough ($10 \sim 20\text{nm}$) to obtain enough directly reflected light bounced back.

Applications

The TohoSpec 6500 is designed to provide accurate film thickness measurements within a vast array of Thin Film Measurement on Substrates of all sizes. With value added options like Contact Angle, Resistivity Heads, Pattern Recognition and XMP software, the TohoSpec 6500 provides multiple critical measurements on a single platform. Common Applications served by the TohoSpec 6500 include the following.

- Displays: Oxides, Nitrides, Photo-Resist, Poly-Silicon
- LCD: a-Si, n+ -aSi, Gate-SiNx, Oxides, PI, ITO, Cell Gap, Photoresist & Polyimide films
- Optical Coating: Hard Coating, Anti-reflective coating, Filters
- Dynamic Glass
- Solar Thin Film
- Other: CRT Photo-resist film, Shadow Masks, Thin metal films, Laser Mirrors
- Films: All partially transparent films up to 100nm thick when using the XMP software application
- Layers: Guaranteed 3 layer measurement and in some cases beyond 3 depending on parameters
- Substrates: Most smooth or semi-smooth surfaces with some reflectance
- Sample Info: Sequence of the film stack, film materials, nominal thickness of each layer



Common Film Configurations Measured by the NanoSpec 6500

SiOx / Glass, Metal	SiOx / Poly-Si / SiOx / SiNx / Glass, Metal
SiNx / Glass, Metal	Poly-Si / SiOx / SiNx / Glass, Metal
a-Si, n+a-Si / Glass, Metal	a-Si / SiOx / SiNx / SiOx / Glass, Metal
ITO / Glass, Metal	Resist / ITO / Glass
PI / Glass, Metal	ITO / SiO2 / Glass
Resist / Glass, Metal	PI / SiO2 / Glass
Ta2O5 / Glass	SiOx / SiNx / Glass
Al2O3 / Al	Ta2O5 / SiNx / Glass

Models

6500

Substrate Size:	410 x 520 through 2160 x 2400
Measurement Head:	SR: Reflectometer / Linear Array
Wavelength:	400 ~ 800 nm
Thickness Range:	10 nm to 35 μ m
Multi-layer:	with XMP up to 3 films simultaneously
Spot size options:	5x 50 μ m, 10x 25 μ m, 50x 5 μ m

6500 – SE

Core Applications:	R&D, thinner than 100 Angstroms
Substrate Size:	730 x 920, 1500 x 1850, 1950 x 2250, 2160 x 2400 (flyi
Measurement Head:	SR: Reflectometer / Linear Array + SE: Elipsometer
Wavelength:	SR: 400 ~ SE: 245 ~ 1000 nm
Thickness Range:	SR: 10 nm to SE: 0nm ~ 2 μ m
Multi-layer:	up to 8 layers subject to sample structure
Spot size options:	5x 50 μ m, 10x 25 μ m, SE: 35 x 8 μ m

6500 – UV

Substrate Size:	620 x 750 through 730 x 920
Measurement Head:	SR: Reflectometer / Linear Array
Wavelength:	200 ~ 800 nm

Thickness Range:	4 nm to 35 μm
Multi-layer:	with XMP up to 3 films simultaneously
Spot size options:	4x 50 μm , 40x 6 μm , 15x 18 μm (UV)