Optical Gauge Series

Optical NanoGauge / Optical MicroGauge

Optical NanoGauge C10178

- Macro field-of-view
- Mapping function

Simply install the fiber-type detector to achieve high-accuracy thickness measurements

Measurable range

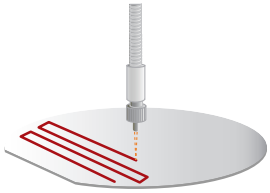
Non-contact measurement from 20 nm to 50 µm in real time

The C10178 Optical NanoGauge is a non-contact film thickness measurement system utilizing spectral interferometry. Film thickness is measured quickly by means of white light illumination. Spectral content of reflections from both thin film surface and substrate interface are analyzed by curve fitting or FFT (Fast Fourier Transform) techniques. A photonic multichannel analyzer (PMA) is used as the detector to measure the spectral content with high sensitivity and high accuracy.

- **High speed and high accuracy**
- **Real time measurement**
- **Precise measurement to fluctuating film**
- **Mapping function**
- **Analyzes optical constants (n, k)**

Semiconductor material

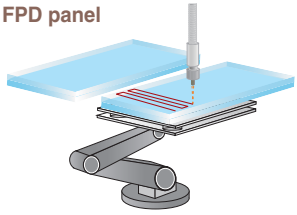
- Film on a wafer
- Thin film



Metal-oxide coating such as SiO_2, SiC, Si and TiO_2
Nitride coating, Resist coating
Polished Si, Optical disk, DLC, Carbon

FPD

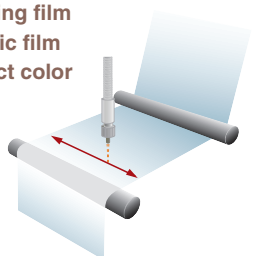
- Film Thickness and color measurement of FPD panel



Cell gap, OLED film, Oriented film, TFT
ITO, MgO and resist on glass substrate
Polyimide, High-functioning film and Color film for FPD

Film

- Coating film
- Plastic film
- Object color



AR coating, PET, PE, PMMA
Coated layer, Deposited film, Functionality film
Acrylic resin

HAMAMATSU

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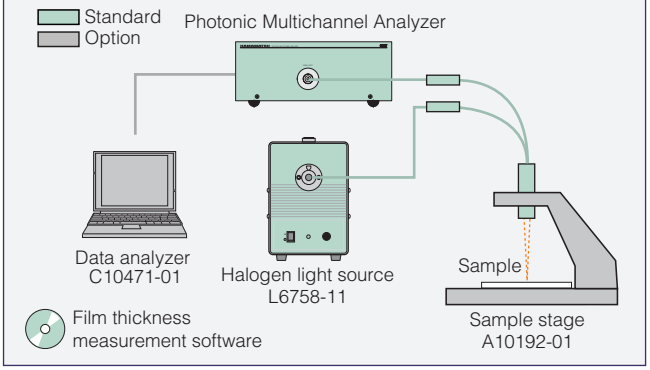
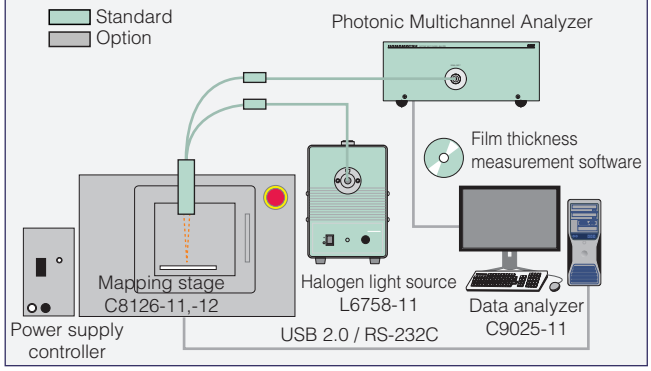
NIR sensitive model in product line for visible-light absorbing sample.

System configurations

standard system



Mapping system for measuring thickness distribution



Specifications

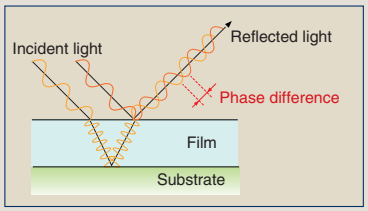
Type number	C10178-01	C10178-03
Measurement models (features)	Standard (for general purpose)	NIR (for visible-light absorbing sample)
Measurement film thickness *1	20 nm to 50 µm	150 nm to 50 µm
Repeatability *2	0.01 nm	0.05 nm
Accuracy *3	±0.4 %	
Light source	Halogen light source	
Measurement wavelength	400 nm to 1100 nm	900 nm to 1650 nm
Spot size *4	Approx. ϕ1 mm	
Working distance *4	10 mm	
Number of measurable layers	Max. 10 layers	
Analysis	FFT analysis, Fitting analysis, Optical constant analysis	
Measurement time *5	19 ms/point	
External control function (option)	RS-232C / inter-software data transfer by PIPE or Ethernet	
Interface	USB 2.0	
Power requirement	AC100 V to 120 V / AC200 V to 240 V, 50 Hz / 60 Hz	
Power consumption	250 VA	230 VA
Fiber connector shape	ϕ12 sleeve shape	

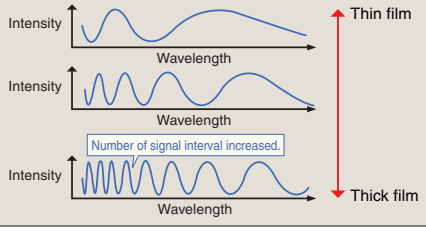
*1: In terms of SiO_2
*2: Standard deviation when measuring a 400 nm thick SiO_2 film
*3: Warranty scope of VLSI standards's warranty
*4: Depending on optical system or objective lens magnification to be used
*5: During continuous data acquisition but excludes analysis time

Principle and features of film thickness measurement

Spectral interferometry is used to measure film thickness.

When light enters a thin film sample, multiple reflections occur inside the thin film. These multiple-reflection light waves boost or weaken each other according to their phase difference. The phase difference of each multiple-reflection light is determined by the light wavelength and optical path length (= distance that light moves back and forth in the thin film multiplied by the film refractive index). This phase difference allows the spectrum reflected from or transmitted through the sample to produce a unique spectrum that depends on the film thickness.
Spectral interferometry is a technique for measuring film thickness by analyzing that particular spectrum. The Optical NanoGauge utilizes spectral interferometry to analyze a target spectrum by the curve-fitting or FFT (Fast Fourier Transform) method that matches your application.





Spectrum of the interference signal (reflected light) along with the wavelength shows the intensity change at each wavelength.

The number of signals is increased as the film thickness becomes thick. The signal intervals in short wavelength range appears more often than those in the long wavelength range.

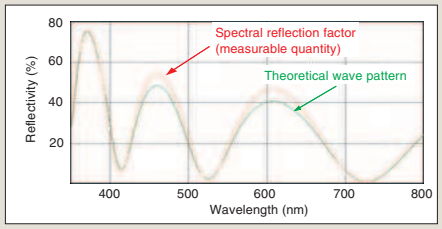
Easily handles height fluctuations. Ideal for making in-line production measurements!

Example of analysis

Analysis by curve fitting

For measuring 1 µm film thickness or smaller

■ Interference spectrum measurement of transparent electrode (ITO film: 350 nm)

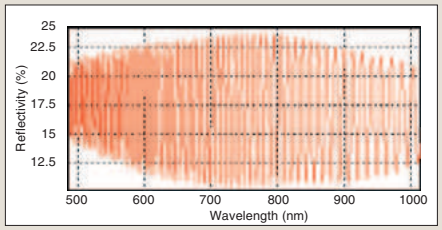


The analyzed film thickness is the theoretical value, which is the least RMS (Root Mean Square) value of the theoretical wave pattern and measurement reflection pattern.

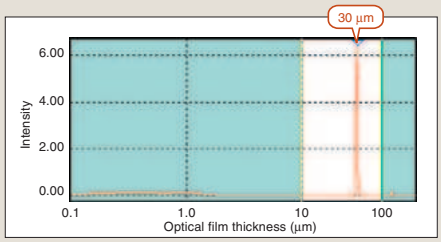
Analysis by FFT (Fast Fourier Transform)

For measuring 1 µm film thickness or more

■ Measurement of etalon (30 µm)



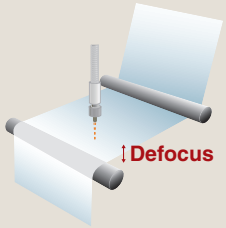
Fourier transform



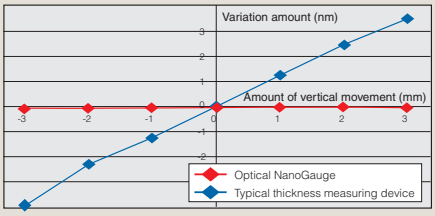
Focus dependence

Measurement of 700 nm thick SiO_2

- Defocus dependence versus reference point: ±3 mm (1 mm pitch), WD of reference point: 10 mm
  Oxide film measurement result Reference value 701.97 nm (± 0.5 %: 698.46 nm to 705.48 nm)



Position	Optical NanoGauge	Typical thickness measuring device
-3 mm	701.59 nm	698.39 nm
-2 mm	701.63 nm	699.92 nm
-1 mm	701.66 nm	701.13 nm
Reference point	701.65 nm	702.37 nm
+1 mm	701.66 nm	703.51 nm
+2 mm	701.67 nm	704.74 nm
+3 mm	701.65 nm	705.91 nm

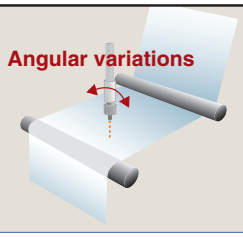


At a vertical movement of 6 mm, the Optical NanoGauge has variations below 0.1 nm, while a typical thickness measuring device exhibits variations up to 8 nm.

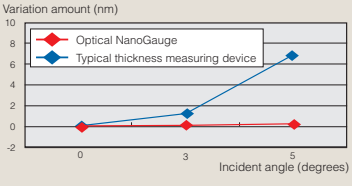
Angular dependence

Measurement of 700 nm thick SiO_2

- Angular dependence versus reference point: 0 degrees to 5 degrees, WD of reference point: 10 mm
  Oxide film measurement result Reference value 701.97 nm (± 0.5 %: 698.46 nm to 705.48 nm)



Incident angle	Optical NanoGauge	Typical thickness measuring device
0 degrees	702.23 nm	702.47 nm
3 degrees	702.29 nm	703.70 nm
5 degrees	702.62 nm	709.38 nm

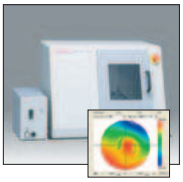


During angular movement from 0 degrees to 5 degrees, the Optical NanoGauge has variations below 0.39 nm (0.047 %) while a typical thickness measuring device exhibits variations up to 5 nm or more.

Wide variety of options including a mapping system

Options

Mapping stage C8126-11, -12



- Measurement time: 2 s/point
- Measurement area: to 140 mm corner (C8126-11)
  <100 mm to 200 mm wafer>
  : to 200 mm corner (C8126-12)
  <100 mm to 300 mm wafer>
- Stage movement resolution: 0.1 mm
- Stage repeatability positioning accuracy: ±0.01 mm

Light Condenser optics

- **Macro optics A10191-01**
  Visible-light condenser lens for A10192-02 sample stage.
- **Macro optics A10191-02**
  Synthetic quartz condenser lens for A10192-03 sample stage.

* Please consult us for C10178-12 optical systems.

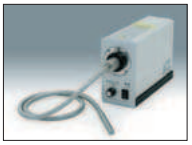
Sample stage

- **A10192-01 (Lensless type)**
  This stage accommodates samples up to ϕ200 mm in diameter. Light condenser not included.

- **A10192-02 (Visible-light condenser lens type)**
  This stage accommodates samples up to ϕ200 mm in diameter. It comes with a visible-light condenser lens with corrected chromatic aberration. (For C10178-01)
  WD: approx. 35 mm, measurement spot diameter: ϕ1.5 mm

- **A10192-03 (Synthetic quartz condenser lens type)**
  This stage accommodates samples up to about ϕ200 mm in diameter. It comes with a condenser lens covering the UV to near infrared light range. (For C10178-03)
  WD: approx. 35 mm, measurement spot diameter: ϕ1.5 mm

LED light source



- **LED light source L11693**
  Wavelength: 420 nm to 720 nm

Data analyzer

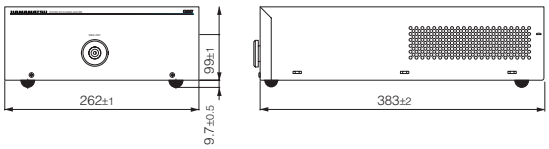
- **Data analyzer C10471-01**
  Note type data analyzer is available as an option.

- **Data analyzer C9025-11**
  A desktop data analysis device for mapping measured results is available.

Dimensional outlines (Unit: mm)

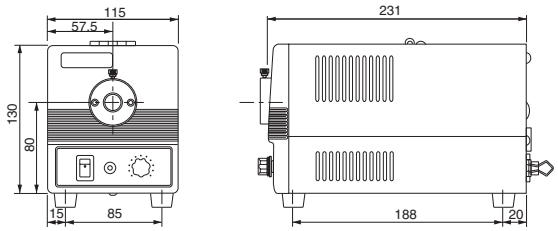
Photonic Multichannel Analyzer (Approx. 5.0 kg)

• C10027-02 (Standard model)



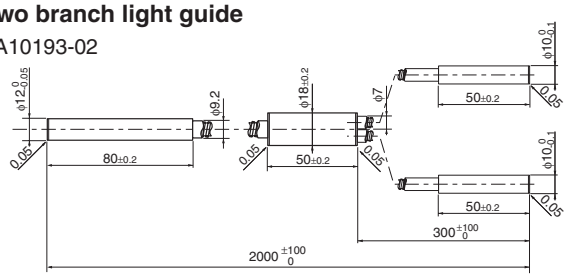
Halogen light source (Approx. 2.6 kg)

• L6758-11



Two branch light guide

• A10193-02



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