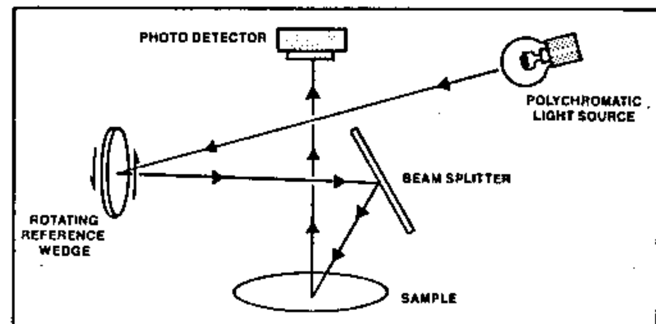
RUDOLPH/FTM
FILM THICKNESS MONITOR

The FTM is the most powerful thin film measuring tool to be introduced in years. The speed, accuracy and simplicity needed for thin film measurements were all designed into the FTM. Oxides, nitrides and photoresists can now be measured in 5 preset positions in far less time then a single point measurement will take using other techniques. This will increase wafer yield through effective and consistent process control.

MEASURING PRINCIPLE

The spectrum of light reflected from a film covered substrate is characterized by maxima and minima at particular wavelengths. These extrema at certain wavelengths are due to the interference of light reflected from the air film boundry and the film substrate boundry. Further, the wavelengths of the extrema depend on the thickness and refractive index of the film.

In the Rudolph/FTM polychromatic light is reflected first from a reference film and then from the film covered surface to be measured. The reference film thickness varies linearly and is "Scanned" by the light beam. The photodetected intensity of the doubly reflected light reaches a maximum as a function of scan position when the optical thickness of the reference film matches that of the unknown sample. This information together with the refractive index selected by the user is used to calculate the film thickness.



The Film Measurement Experts

RUDOLPH RESEARCH

RUDOLPH/FTM

DESCRIPTION

The Rudolph/FTM Film Thickness Monitor has a unique optical and electronic system capable of making precise, non-destructive film thickness measurements in less than 4 seconds. The FTM performs with the same speed and precision whether the films are resists, oxides, nitrides or polysilicons; whether the substrate is silicon, GaAs, glass or chrome. In fact, the FTM is so versatile it can measure on either control wafers or directly on product without any need for critical sample alignments.

For most measurements, simply set the film type dial to the proper setting, insert the sample, and in less than 4 seconds the measurement is completed and the thickness data will be presented on the LED display.

There are two models with several options to satisfy your particular needs. The standard FTM is for general film thickness measurements, while the FTM-R has additional features specifically designed to meet the requirements of photoresist on chrome mask measurements. Available options include an extended range feature, the TR-1, which increases the measurement range of the FTM and FTM-R to a maximum optical thickness of 10500nm. There are also 2 automatic scanning stages available for multi point measurements across the sample.

An SS242 with the standard FTM and the SS242R with the FTM-R.

This brochure illustrates the features and specifications of the Rudolph/FTM and describes the options that are available. We are eager to provide further information if needed and to assist you with your particular application.

FEATURES

Precise: 1nm resolution
Fast: 4 seconds per measurement
Fast Operation: set film type dial, insert sample and measure
Non-destructive: Non contact optical system
Flexible: Measures wide range of film types and thicknesses
Low Cost: About 1/3 the price of other techniques

MEASURING PRINCIPLE

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SPECIFICATIONS

MODEL	FTM	FTM-R	WITH OPTION TR-1
Optical Thickness[1] (Typical)	300nm to 5,000nm	300nm to 5,000nm	600nm to 10,500nm
Reproducibility	±2nm	±2nm	±4nm
Resolution	1nm	1nm	1nm

OPTICAL THICKNESS RANGE[1]		ACCURACY AND LINEARITY[2]	
300 to 375nm	±5%	±5%	—
375 to 450nm	±3%	±3%	—
450 to 825nm	±2%	±2%	—
825 to 5,000nm	±1%	±1%	—
600 to 750nm	—	—	±5%
750 to 1,200nm	—	—	±3%
1,200 to 2,000nm	—	—	±2%
2,000 to 10,500nm	—	—	±1%

	FTM	FTM-R	WITH OPTION TR-1
Refractive Index Range[3]	1.000 to 9.999	1.000 to 9.999	1.000 to 9.999
Typical Measurement Time	<4 Seconds	<4 Seconds	<5 Seconds
Light Source Emission	<400nm — NIR	<480nm — NIR	<400nm — NIR (FTM) <480nm — NIR (FTM-R)
Spot Size (Nominal)	2 × 6mm	2 × 6mm	2 × 6mm
Weight	45 lbs.	45 lbs.	45 lbs.
Dimensions	17"W × 17"D × 13½"H	17"W × 17"D × 13½"H	17"W × 17"D × 13½"H
Power Requirements	115V/230V, 50VA	115V/230V, 50VA	115V/230V, 50VA

NOTES: 1. Optical thickness = film refractive index (633nm wavelength) × physcial thickness of film.
2. Data is for transparent films on silicon.
3. Calibration dial numbers read the approximate refractive index of the film at 633nm wavelength.

TYPICAL APPLICATIONS AND THICKNESS RANGES

Applications for the FTM are almost limitless, not only in the semiconductor industry, but in any industry where there is a need to measure transparent or partially transparent films over a reflective substrate. A few applications are listed below:

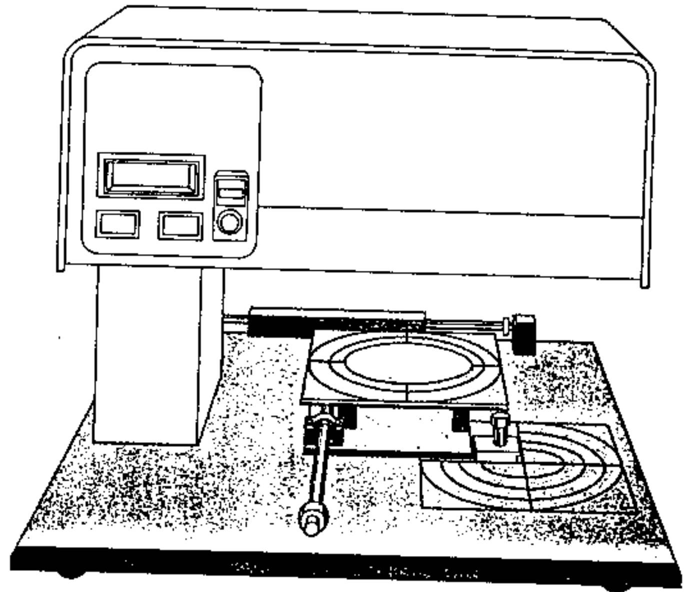
FILM TYPE	RUDOLPH/FTM & RUDOLPH/FTM-R	WITH OPTION TR-1
Negative Resist	200nm — 3000nm	400nm — 6300nm
Positive Resist	200nm — 3000nm	400nm — 6300nm
E Beam Resist	200nm — 3200nm	400nm — 6700nm
Silicon Dioxide	200nm — 3500nm	400nm — 7000nm
Silicon Nitride	150nm — 2500nm	300nm — 5250nm

ADDITIONAL APPLICATIONS

Silicon on Sapphire
Polysilicon on S_iO_2 on Silicon
Polyimide on Silicon
Pellicles

RUDOLPH/FTM

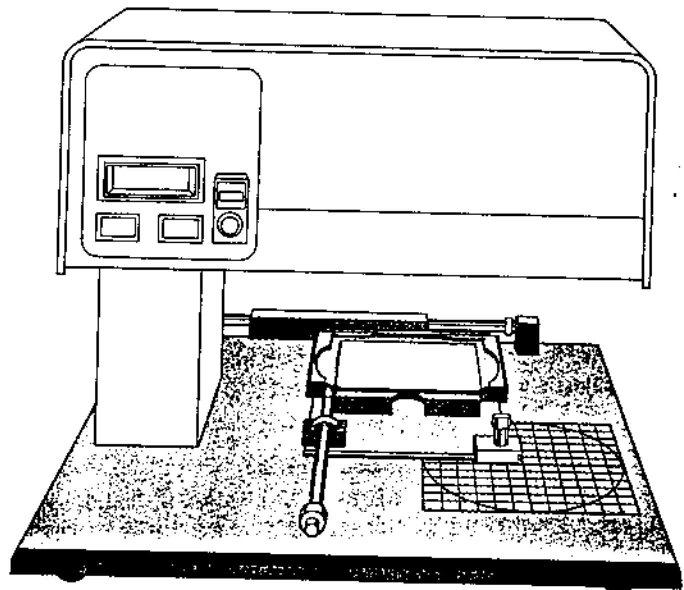
The standard model of the FTM was designed for general film thickness measurements. The sample stage accepts round or square samples up to 6″ in diameter, and has manual translation across the entire sample surface. This model will measure film thickness covering an optical thickness range of 300nm to 5000nm.



RUDOLPH/FTM-R

The FTM-R sample stage is made of PVC with recesses for 4½″, 5″, and 6″ square as well as 6″ round photomasks. Like the standard FTM, the FTM-R stage will also accept round wafers and is manually translatable.

The FTM-R is equipped with short wavelength blocking filters to protect unexposed photoresist during measurement. The thickness measurement range of the standard FTM-R is 300nm to 5000nm.



OPTIONS

TR-1 — will extend the measurement range of either FTM model to cover a range of optical thickness of 600nm to 10,500nm.

SS242 — New Automatic Scanning Stage — This microprocessor controlled X, Y stage can be programmed to store 1 to 20 measurement points on samples up to 6″ in diameter. Measurement point coordinates may be selected and stored locally through keyboard or remotely by a host computer. Learn mode enables the operator to move a sample to desired measurement locations using joystick control; measurement coordinates are remembered by FTM for subsequent sample measurements. Prints out the individual film thicknesses along with their X, Y coordinates, mean averages, and standard deviation are presented via the built in printer.

SS242R — is designed to be used with our FTM-R. The design is the same as the SS242 except the stage is PVC with recesses for 4½″, 5″ & 6″ square as well as 6″ round photo masks.

STANDARD CHECK SAMPLES
2 calibrated Silicon Dioxide check samples are included with each FTM.