Ellipsometer – Rudolph

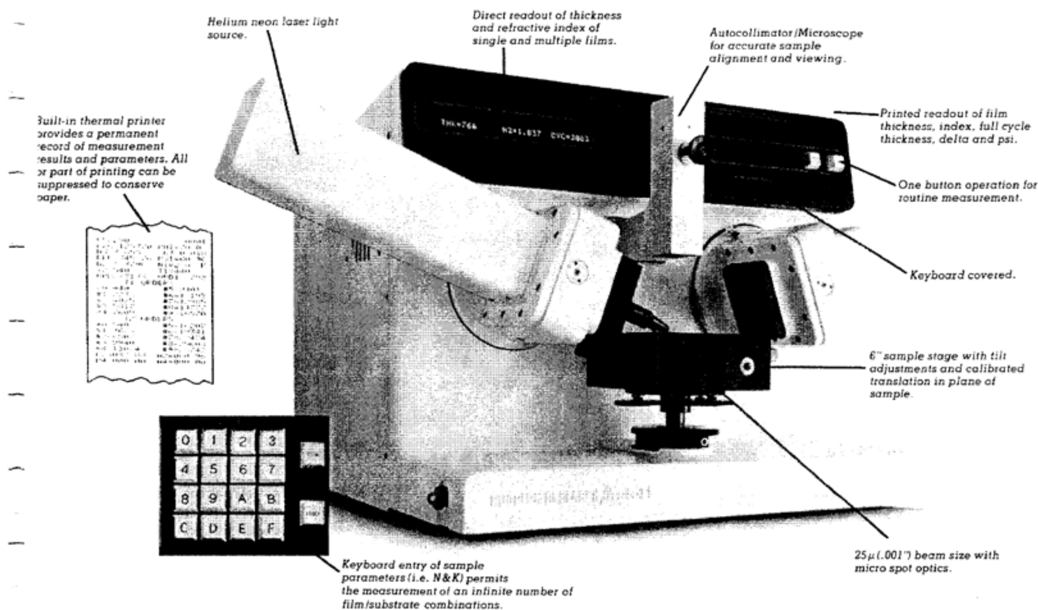
ID: met-4 Location: FabLab Front

The Auto ELIII Ellipsometer is used to measure the optical constants of bare surfaces as well as refractive indices, full-cycle thicknesses, and zero- through ninth-order thicknesses of thin single- or double-layer transparent films on opaque materials. The optical constants are automatically computed and displayed from the raw measurement data.

Technical Specifications:

The AutoEL® III

Automatic Ellipsometer



ALL NEW FEATURES

Automatic Measurement of Double Layer Transparent Films

AutoEL® III capability is extended to thickness and refractive index measurements of double layer transparent films such as nitrides over oxides and to the measurement of the optical constants of bare substrates such as silicon, gallium arsenide or gallium arsenide phosphide with direct readout of N and K.

Non-Volatile Memory

AutoEL® III contains non-volatile memory to store frequently used program specifications and input data. Stored information can be recalled by pressing one button. This feature of the AutoEL® III has the ability to handle complex multilayer measurements while retaining simplicity of operation.

Micro-Spot Optics

AutoEL® III has an optional reduced beam size of twenty five (25μ) microns permitting measurements within scribe lines and in areas as small as 25 X 75 microns. The micro-spot optics are removable for normal operation.

Autocollimator/Microscope

AutoEL® III provides a unique Autocollimator/microscope design which permits accurate sample alignment as well as clear and easy viewing of areas of interest on patterned wafers. These features are essential to measurement accuracy, particularly when samples are not perfectly flat and where the precise location of areas to be measured is critical.

RUDOLPH RESEARCH
the Ellipsometry Experts

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TECHNICAL BULLETIN 540A

FEATURES AND SPECIFICATIONS

The AutoEL® III

Automatic Ellipsometer

OPERATING PRINCIPLE Null Seeking

OPERATING WAVELENGTH 632.8nm

RESOLUTION & ACCURACY

Polarizer or Analyzer	0.05°
DELTA	0.1°
PSI	0.05°

Resolution and accuracy of measured film thickness and film or substrate refractive index depends on the film-substrate system and the film thickness. 3 to 10 Angstroms and 0.01 refractive index units are typical for silicon oxide films on silicon.

ANGLE OF INCIDENCE

Standard Pin Locations 70°± 0.02° and 90°±0.02°
Optional Pin Locations 60° & 80°

Optional pin locations are available at additional cost. Non-pin located angles may be set with specially cut alignment prisms.

MEASURING TIME

Typical

Single Film	15 seconds
Double Film	20 seconds

DISPLAY

Displays film thickness, index, order thickness, substrate N and K as well as prompting messages to the operator.

DIGITAL OUTPUT Serial ASCII, RS-232

RUDOLPH and SEMI Communication Standards.

MAXIMUM SAMPLE SIZE AND MOUNTING PLANE

6"X 6"(15.2cm X 15.2cm). Horizontal with vacuum holddown. Vacuum source not supplied.

STANDARD EQUIPMENT

Sample Stage:

The standard sample stage has vertical adjustment plus tilt adjustments about vertex of angle of incidence and about axis formed by intersection of plane of incidence with plane of sample.

Data Reduction:

Provides an integral library of unique programs and is easily upgradeable as future programs become available.

Autocollimator/Microscope

Microscope magnification 9X. Field of view 15mm. Internal light source for normal incidence sample illumination.

Thermal Printer

Built-in. Dot-matrix format. Alpha-numeric.

OPTIONAL EQUIPMENT

Option 2: Sample Stage

Option 2 sample stage has vertical adjustments plus two-axis tilt adjustments, plus two calibrated orthogonal translations in the plane of the sample. Translation range 1" (2.54cm), resolution 0.001" (0.025mm) in both directions.

Option 4A: Microspot Optics

Spot Size 0.001" (25μ)

The optional microspot optics are designed to be attached by the user to the polarizer module. Note that, although the beam cross-section is circular, the obliquely-illuminated sample area is elliptical — e.g., at 70° angle of incidence, the minor and major axes of the spot are 0.001" and 0.003" respectively.

Option 6: Angle of Incidence Alignment Prisms

Any fixed angle	60° to 90°
Accuracy, all prism angles	10 arc-seconds

DIMENSIONS

Without laser head	17⅜"H, 21¼"D, 21½"W
With laser head	17⅜"H, 21¼"D, 27½"W

WEIGHT 87 lbs. (39kg)

WARRANTY

The Rudolph Research AutoEL III carries a one year limited warranty. Detailed warranty information available upon request.

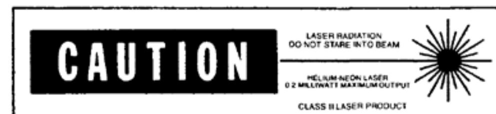
For a Demonstration or Further Information Contact

RUDOLPH RESEARCH

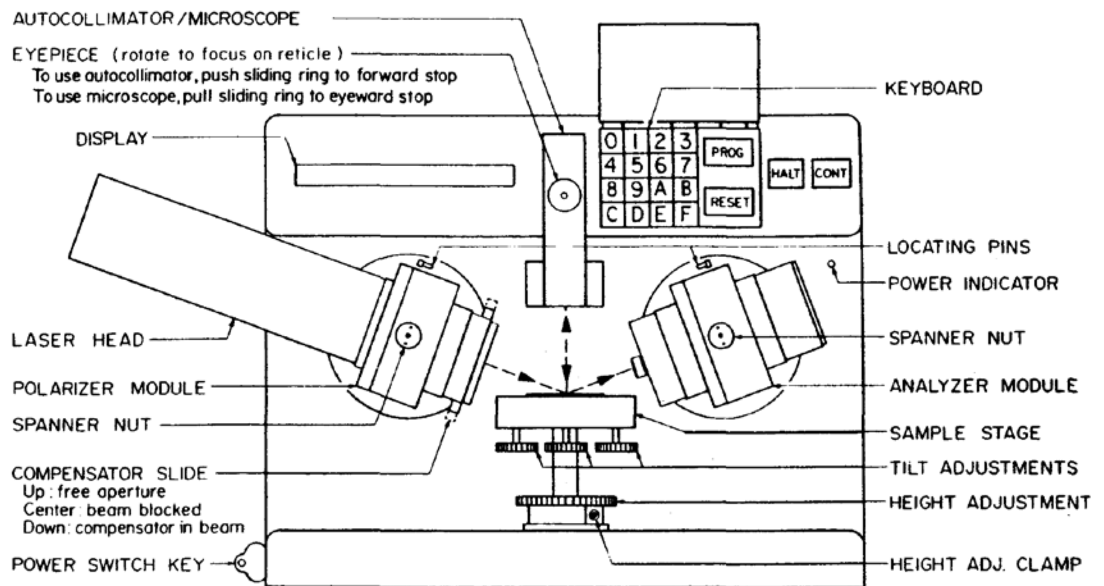
1 Rudolph Road, Box 1000
Flanders, N.J. 07836 (201) 691-1300

LASER SAFETY

The AutoEL III is a Class II laser product as defined by Federal Regulations 21 CFR 1040, and meets all applicable performance and labeling requirements of those regulations. The helium-neon laser light source in the AutoEL III is a low-power laser which emits only the 632.8nm red line at a level of 0.2 milliwatt maximum. As with any high-luminance source such as the sun or an arc lamp, the operator should not stare directly in the laser beam or into its reflection from highly reflecting surfaces. The caution label is reproduced below.



RUDOLPH RESEARCH AutoEL®-III CONDENSED OPERATING INSTRUCTIONS



START-UP

1. A. <u>If power is off,</u> turn power switch key to 'on' position. Power indicator will light, and within 30 seconds display will read **UP COMP-INSERT SAMPLE-PRESS CONT.** Wait 15 minutes before proceeding, to permit warm-up. If printer power is off, turn printer on.

B. <u>If power is on,</u> press RESET key. Within 30 seconds display will read **UP COMP-INSERT SAMPLE-PRESS CONT.** Initialization can be performed immediately if instrument is already warmed up. If printer power is off, turn printer on.

INITIALIZATION PROCEDURE

2. Set angle of incidence if required, in accordance with Par. 4-5ff in AutoEL-III Manual.

3. Place initialization sample on sample stage, approximately centered and with reflecting side up. The initialization sample may be a silicon wafer with an 1100 Å to 1300 Å SiO_2 film, such as the check sample, RR Part No. A7932-1100.

4. <u>Adjust sample height</u> to reflect laser beam into analyzer entrance aperture, then securely tighten height adjustment clamp.

5. <u>Adjust sample tilt as follows:</u> Push plastic ring on barrel of autocollimator zoom eyepiece to its forward stop (i.e., away from operator), and rotate tilt-adjusting screws to center the white spot visible through autocollimator eyepiece. All tilt-adjusting screws must be thumb-tight when adjustment is complete.

6. Push compensator slide up, and press CONT key. When display reads **DOWN COMP-PRESS CONT OR PROG,** push compensator slide down.

MEASUREMENT ON CHECK SAMPLE

7. If sample used for initialization was not a check sample, remove initialization sample and place SiO_2/Si check sample on sample stage, approximately centered.

8. Readjust sample height and tilt if required, as in steps 4 and 5.

9. Select program 210000 (for 2-zone measurement of SiO_2 on Si samples) by sequentially pressing PROG key, then keys 2, 1, 0, 0, 0 and 0 or 2, 1 and E (which automatically inserts the trailing zeros).

10. Note displayed and printed results.

A. If any error message is displayed during a run, see Appendix G of AutoEL-III manual for explanation and correction. These error messages may be used to diagnose whether troubles are caused by operator error, poor sample alignment, unsatisfactory sample properties, incorrect data, invalid calculations, or instrument malfunctions.

B. Even if error messages are not displayed, values significantly different from those expected may result from operator errors that do not cause error message displays. To eliminate this possibility, press RESET, wait 30 seconds, return to step 2, and repeat initialization and check sample measurement procedures.

SUBSEQUENT MEASUREMENTS

11. Remove previous sample and place next unknown sample on stage. Check height and tilt; readjust if required, as in steps 4 and 5.

12. Specify desired program, as follows:

A. To use stored program specification C, press CONT.

B. To make recall entry of program specifications stored in memories C, D, E, or F, press PROG, then press key C, D, E, or F. (See Par. 4-36 in AutoEL-III manual for procedure of storing program specifications in memories C, D, E, and F).

C. To make direct entry of program specifications, press PROG, select desired program specification from list, enter six-digit program specification number via keyboard, then press key E.

D. To make prompted entry of program specifications, press key B, then respond to prompting questions when displayed.

E. To repeat the program specified in step 12A, B, C, or D, press CONT.