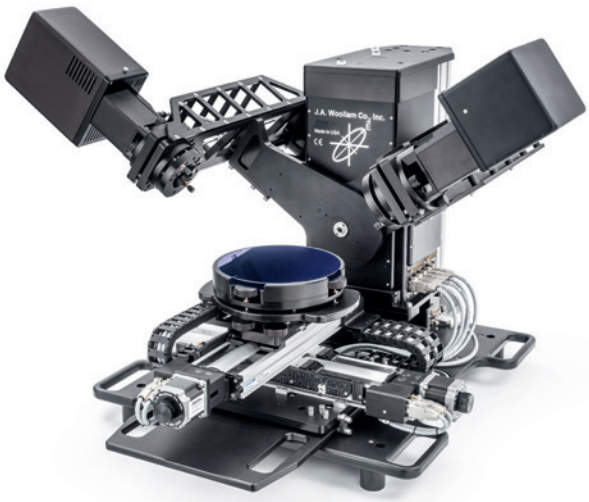
RC2®

Specification sheet 2018

The RC2® is the latest spectroscopic ellipsometer (SE) from the J.A. Woollam Co., featuring the most advanced optical design and performance of any SE system world-wide.



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Features

Patented Dual Rotating Compensator Ellipsometer (D-RCE) Technology

RCE technology overcomes the limitations of other ellipsometers.

	D-RCE	RCE	RAE	RPE	Phase Modulated
Measure all Ψ/Δ accurately	Yes	Yes	No	No	* Requires 2 measurements
Measure Δ handedness	Yes	Yes	No	No	Yes
Measure Depolarization	Yes	Yes	No	No	*Requires 2 measurements
Combine with fast CCD detection	Yes	Yes	Yes	Yes	No
Measure full Mueller Matrix	Yes	No	No	No	No

Innovative Spectrometer

Advanced silicon CCD combined with InGaAs array allows the RC2 to measure hundreds of wavelengths from UV to NIR in less than a second.

Wide Spectral Range

The RC2 is available in a variety of spectral ranges with options from the UV to the NIR. The widest spectral range is 193-1690 nm or 210-2500 nm with simultaneous data collection at ~800 or more wavelengths.

Enhanced Alignment Tecnology

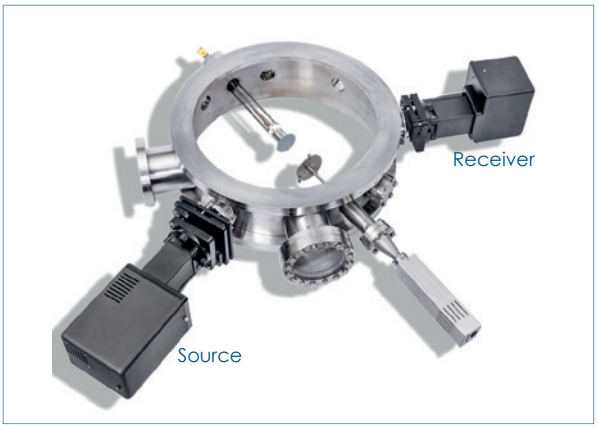
The RC2 includes multiple integrated alignment detectors and position sensitive detections to maintain precise beam positioning. Alignment information can be recorded during data acquisition.

Software

Ellipsometry is an effective characterization technique, but requires powerful software to get full benefit from the measurement. Our CompleteEASE® (*in situ/ex situ*) software packages provide easy calibration, data acquisition, and analysis for all of your applications.

In Situ RC2

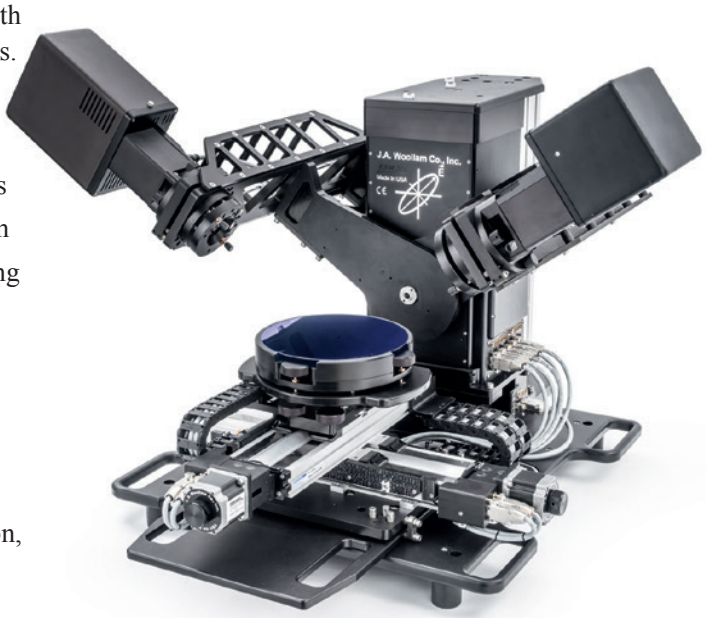
With fast measurement speed and high accuracy, the RC2 is a perfect match for real-time deposition/etch monitoring and control.



RC2 attached to a process chamber.

Ex Situ (Benchtop) RC2

The RC2 is offered on a variety of bases to meet your application and budget. Choose from fixed angle or automated angle with either horizontal or vertical sample mount. Additional options include focusing optics, manual or automated sample translation, heat stages, liquid cells, and more. See pages 5-7 for available options.



RC2 with automated angle base, featuring a horizontal sample mount.

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System specifications

Spectral Range

Model:

U	210nm to 1000nm, 790 wavelengths
X	210nm to 1000nm, 790 wavelengths
D	193nm to 1000nm, 800 wavelengths
NIR extension	1005nm to 1690nm, 275 wavelengths
XNIR extension*	1005nm to 2500nm, 250 wavelengths

**optional with model X only*

Spectral Resolution Bandwidth

Model:

U, X, D: 1nm wavelength spacing, < 2.5nm FWHM
NIR ext: 2.5nm wavelength spacing, < 3.5nm FWHM
XNIR ext: 6nm wavelength spacing, < 15nm FWHM

**Spectral resolution is defined as both the wavelength spacing and the full-width-half-max (FWHM) bandwidth of each wavelength. To estimate FWHM, a monochromatic light source is scanned through the spectrometer at different wavelengths.*

Beam Diameter

Standard beam is collimated with 3-4mm diameter.

Beam Divergence

Less than 0.4°

Measurement Quantities

Spectroscopic Ellipsometry:
Ψ = (0-90°) and Δ = (0-360°)
N, C, and S
Intensity: % Transmission and % Reflection
Depolarization: % Depolarization
Generalized Ellipsometry*:
AnE, Asp, and Aps (3 rations of generalized Jones Matrix)
Mueller Matrix*:
All 15 normalized elements of the Mueller Matrix (normalized to m_{11})

**Useful for measuring and characterizing anisotropic materials with cross-polarization.*

Data Acquisition Rate

Complete acquisition cycle for SE or full MM data is 0.3 seconds. For best signal-to-noise, measurements are typically averaged at 2-10 seconds at each angle.

Straight-Through Accuracy

Ten second measurement of empty-beam, met by 95% of all wavelengths:

Models U, X, or D and NIR:
Psi: 45° ± 0.02°
Delta: 0° ± 0.05°
Depolarization: 0% ± 0.5%
15 normalized Mueller Matrix elements:
Diagonal: 1 ± 0.002
Off-Diagonal: 0 ± 0.002

Model X+XNIR:
Psi: 45° ± 0.03°
Delta: 0° ± 0.08°
Depolarization: 0% ± 0.5%
15 normalized Mueller Matrix elements:
Diagonal: 1 ± 0.005
Off-Diagonal: 0 ± 0.005

Thickness Precision

Thirty consecutive (static) ten second measurements of nominally 25nm SiO2/Si:

Standard deviation in thickness < 0.005nm

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Component specifications

System Configuration (in order)

Source
Polarizer
Rotating Compensator
Sample
Rotating Compensator
Polarizer
Spectrometer

Light Sources

Model:

X: Xenon lamp
U and D: Combined Deuterium/Quartz-Tungsten Halogen lamps

Fixed Polarizers

Model:

U and X: α-BBO
D & XI+: MgF_2 Rochon

Compensators

Patented achromatic design

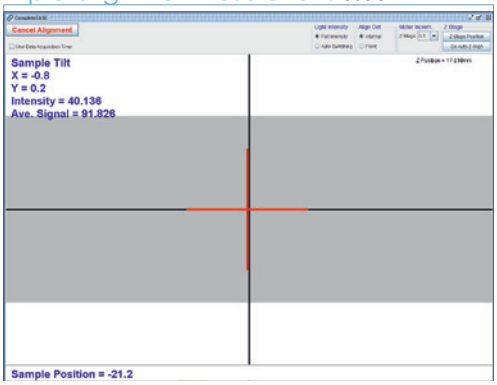
Detectors

Backthinned silicon CCD array (UV/VIS)
InGaAs photodiode array (NIR)
Strained TE-cooled InGaAs array (XNIR)

Integrated Alignment Detector

Built-in electro-optic alignment detector is divided into four quadrants. Cross-hair generated by the detector assists accurate alignment. The figure below shows the alignment screen.

Sample alignment resolution: 0.001°



RC2 Electronics Box

Contains DC power supplies for the system, a USB connection for communicating with the windows host computer (and a USB hub for communicating with the other system components), and a single board computer which controls the stepper motor drivers that move the angle of incidence arms and translation stages (if applicable).

Operator Computer (Optional)

Core i7-8700 Processor
8GB RAM
500GB Hard Drive
Windows 10Pro-64 bit
8x DVD+/-RW Drive
22” monitor
MiniTower Case

**Minimum specifications, subject to change without notice.*

CompleteEASE® Software

Designed for *Ex situ* and *In situ* applications. Data acquisition, data analysis, optical simulations, routine calibrations and mapping routines.

Options

Available Bases

All bases include 3 axis sample alignment.
X and Y (tip and tilt) resolution: 0.001°
Z (height) resolution: 5 µm

Test Base

Angle of incidence: ~ 65°
Accuracy: ± 0.2°
Repeatability: 0.005°
Horizontal sample mount
Max sample size: 150mm dia.
Max sample thickness: 20mm

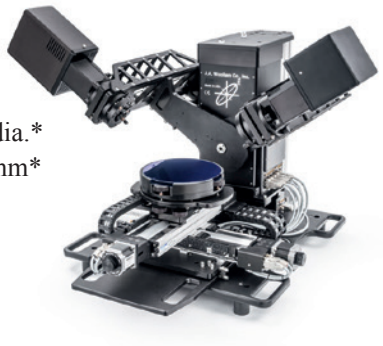
Vertical Automated Angle Base

Angle of incidence: 20°-90°
Accuracy: ± 0.02° or better
Repeatability: < 0.005°
Vertical sample mount via vacuum chuck
Max sample size: 200mm dia.
Max sample thickness: 20mm

** Vertical base simplifies acquisition of transmission ellipsometry and transmission intensity data.*

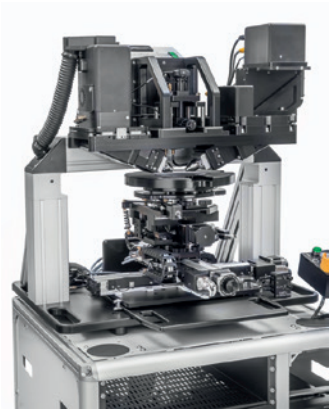
Automated Angle Base

Angle of incidence: 45°-90°
Accuracy: ± 0.02° or better
Repeatability: < 0.005°
Horizontal sample mount
Automated z-height
Max sample size: 300mm dia.*
Max sample thickness: 18mm*



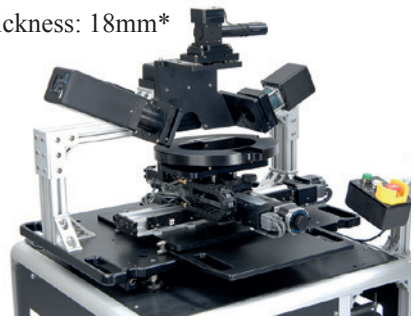
Focused Base

Angle of incidence: ~ 65°
Horizontal sample mount
Automated z-height
Max sample size: 300mm dia.*
Max sample thickness: 18mm*



Fixed Angle Base

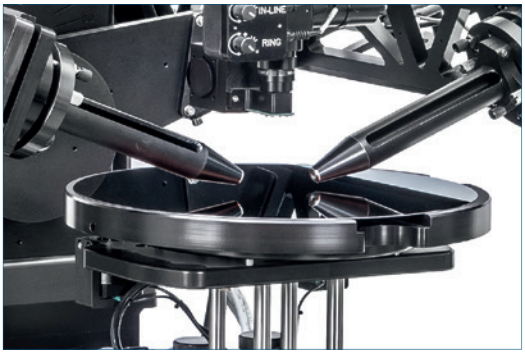
Angle of incidence: ~ 65°
Horizontal sample mount
Automated z-height
Max sample size: 300mm dia.*
Max sample thickness: 18mm*



** Maximum sample size depends on system configuration. Options for larger or thicker samples may be available. Contact J.A. Woollam for details.*

Options

Focusing Optics



Model (on Fixed or Auto Angle Base)

U, UI, D, DI	300µm beam diameter
X, XI	120µm beam diameter

Model (on Focused Base)

X	25µm x 60µm

Sample Translation

Manual

50mm by 50mm XY
100mm by 100mm XY (*horizontal only*)
*Minimum step = 5µm

Computer Automated

50mm by 50mm XY *(vertical only)*
100mm by 100mm XY (*horizontal only*)
200mm by 200mm XY (*horizontal only*)
300mm by 300mm XY (*horizontal only*)
*Minimum step = 2.5µm

**Larger translation options may be available, contact us for details.*

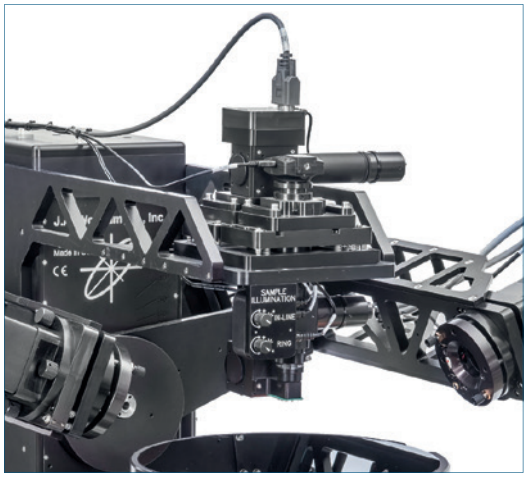
Camera

Add a camera to RC2 systems with focused spot option to visualize the measurement area. The actual beam may not be visible on smooth surfaces, but the location can be identified based on reference location. The camera option includes a 3.15Mpixel CCD Camera, Lens set, and Illumination setup.

- 3x Magnification
- Field of view: 2.1 x 1.6mm
- Working distance: 77mm
- Digital zoom: up to 8x

Automated Sample Alignment

Fully automated sample alignment (tip/tilt and z-height adjustment).



Options

Integrated Table

Table designed specifically for RC2. Rack for mounting electronic boxes, fully enclosed computer and wires. Monitor, keyboard and mouse mounted on arm.

Enclosed Table

Integrated table with rack mount for electronics, computer, EMO, storage, and complete enclosure with easily removal panels, designed to introduce samples through lift-able front panel.

Liquid Cells

Liquid cells include optical windows for measurement through liquid ambient. Allows for study of liquid/solid interfaces. For more detailed information please contact the J.A. Woollam Co. for the liquid cell spec sheet.

Liquid Cell Name	Liquid Capacity	Angle of Incidence
5mL Horizontal *(pictured)*	5mL	75°
500µL Horizontal	500µL	70°
2mL Electrochemical Horz.	2mL	70°
5mL Heated Horizontal	5mL	75°
500µL Variable Temp. Horz.	500µL	70°
37mL Electrochemical Vert.	37mL	70°

Facility requirements

Operating Environment

A sturdy table (weight of instrument is system dependant, contact JAWCo to discuss).
Range of Weights: 50-150 lbs.
Integrated Table with rack mount cabinet (optional)
Note: Vibration isolation table is not required

Power

100-240 VAC, 50/60Hz, 5 Amps max.

Dimensions

Dimensions vary depending on options. Approximate dimensions for arger system (RC2 DI with 300mm XY mapping and integrated table) are given in the drawings to the right.

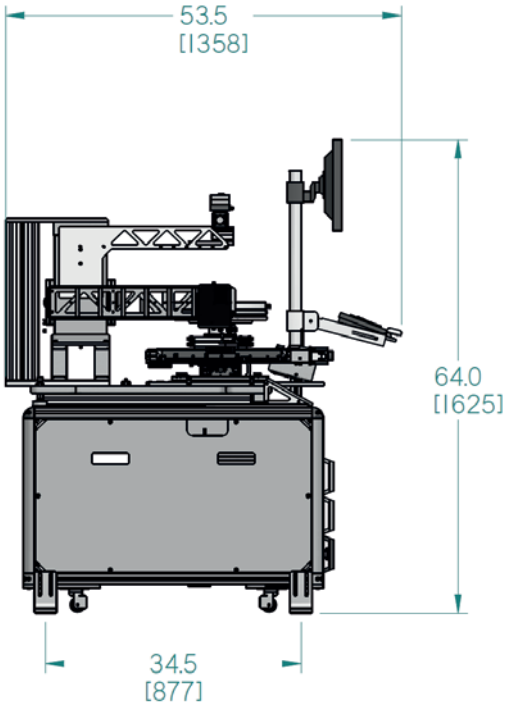
Table Layout

Recommended size:
- Width 60”
- Depth 30”
- Height 36”
- *With shelf or 19” rack mount below (optional)

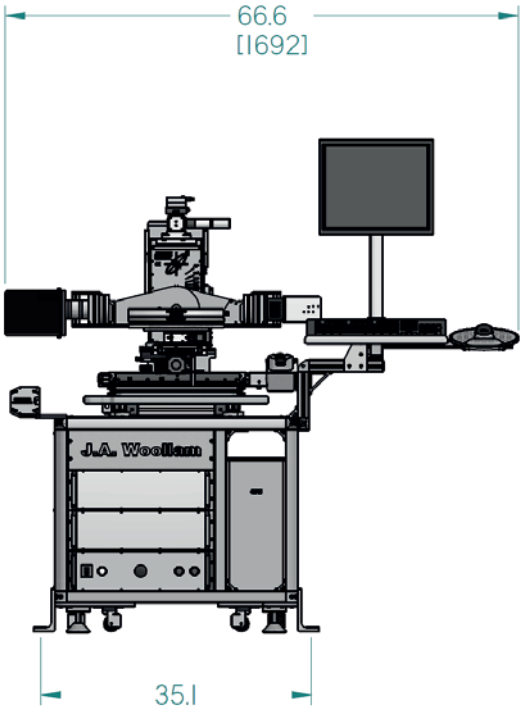
Ambient Lighting

D-RCE technology allows accurate measurements under normal room light conditions.

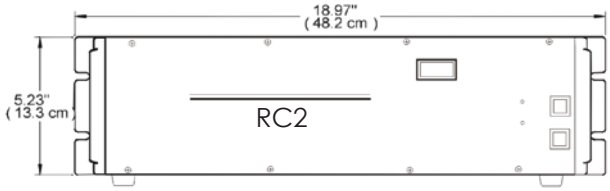
RC2 Side View
Dimensions given
in inches (mm)



RC2 Front View



RC2 Detector Box*



*standard rack mount cases, 24" deep

RC2 References

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