



FlexCam™

4D Technology

Defect and Roughness Metrology Module

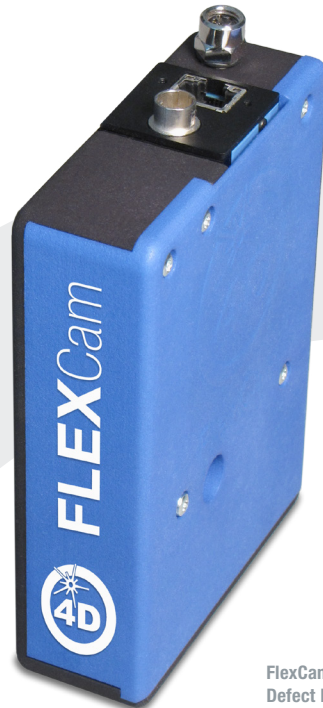
The FlexCam is a compact, high resolution 3D metrology module for **in situ roll-to-roll measurement** of substrates, barrier films and intermediate layers. FlexCam modules provide sub-nanometer vertical resolution and micrometer-scale lateral resolution for in-process roughness and defect quantification.

Surface roughness and defects affect the longevity of components deposited on substrates. FlexCam enables **real-time monitoring and control of roughness** to less than 0.5 nm rms, both inclusive of and exclusive of defects on the film. The system provides accurate measurement despite runout, web flutter, and other effects which can vary the location of the substrate relative to the measurement system. No other system can match its performance.

FlexCam also **identifies and quantifies defects**, registering their position within the roll. Multiple defect statistics are calculated including area, volume, depth and slope, with user-selectable pass/fail criteria as each metric can have adverse effects on barrier or end device performance. Extrinsic versus intrinsic defects can be discriminated to help isolate their root cause. Bright-field inspection systems are sensitive to the backside of the film as well as the roller surface, but 4D's FlexCam is immune to such effects, measuring only the top surface.

Every FlexCam module provides **thousands of times more areal coverage than off-line bright-field or 3D microscopes**. Each FlexCam module can provide 100% inspection in the machine direction for web speeds up to 1 meter per minute. In addition, FlexCam modules can be arrayed across a web, offering as much or as little sampling in the transverse direction as required.

Each module processes all data on-board, calculating and **reporting statistics in real-time**, for incredible processing speed. In production mode, simple controls and pass/fail criteria make it easy to monitor the process. In engineering mode, 2D analyses, statistics and visualization tools help you to quickly dial in process parameters and examine individual defects with high fidelity.



FlexCam Roughness and Defect Metrology Module

APPLICATIONS

- Defect Detection, Quantification and Analysis
- Sub-nanometer Roughness Measurement
- Substrates, Barriers and Intermediate Films down to 25 μm Thickness
- Thousands of Times Faster Than 3D Microscopy
- Immune to Backside and Roller Reflections
- Scalable—Gang Modules for Greater Coverage

FlexCam™

Specifications

Description	FlexCam Metrology Module
Vertical Resolution*	< 0.5 nm
Lateral Sampling**	2.0 µm
Snapshot Field of View	0.2 mm machine direction x 4.0 mm transverse direction
Standoff Distance	21 mm
Focus Range	±30 µm; automatically tracks surface despite roller runout or web flutter
Maximum Measurable Step	115 nm
Maximum Measurable Slope	3.3 degrees
Acquisition and Analysis Time†	< 33 msec
Substrate Thickness Range	25 µm to > 1 mm
Substrate Reflectivity	1% – 30%; optional capability for highly reflective substrates
Maximum Substrate Speed	1 meter/minute for 100% coverage in machine direction
Maximum Allowable Roller Runout	±25 µm
Minimum Roller Diameter	6 in (15.2 cm)
Roller Coating	black anodize or similar
Operating Temperature	10–30° C (50–86° F)
Operating Humidity	> 98% non-condensing
Module Size	175 x 95 x 24 mm (6.9 x 3.75 x 0.95 in)
Module Weight	0.5 kg (1.1 lb)
Module Power Consumption	< 8 W /module
Module Array Options	Up to 60 modules across 1 meter substrate
Analyses	Overall surface roughness (rms, peak-to-valley, average) Surface roughness excluding defect areas (rms, peak-to-valley, average) Overall defect coverage (ppm) Number of defects Individual defect statistics including maximum slope, area, volume, maximum height, location on substrate
Warranty	One Year, limited

* Difference between two successive measurements on smooth (<1 nm Ra) surface

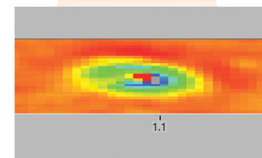
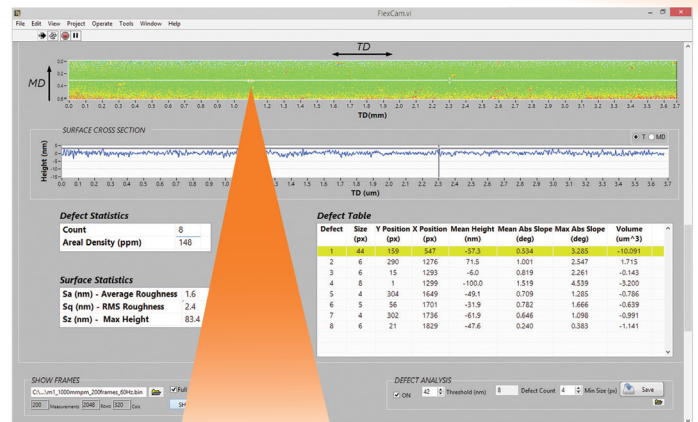
** Pixel size of the camera as projected onto the test piece

† Time to acquire a field of view, calculate and report surface statistics and defects

FlexCam is a trademark of 4D Technology Corporation.

Patent Pending.

All specifications subject to change without notice.



An array of FlexCam modules can image the entire surface of a 1 meter wide web moving at 1 meter/minute.

A typical output screen from a FlexCam module is shown. Defect statistics, surface roughness, and information on each found defect are calculated.

A false-color height map of a rod-shaped defect is highlighted in the inset at bottom.