BIO-RAD

M41

MICROMEASUREMENT SYSTEMS

M41 MASK AND WAFER SYSTEMS

MICROMEASUREMENT FOR THE SEMICONDUCTOR INDUSTRY

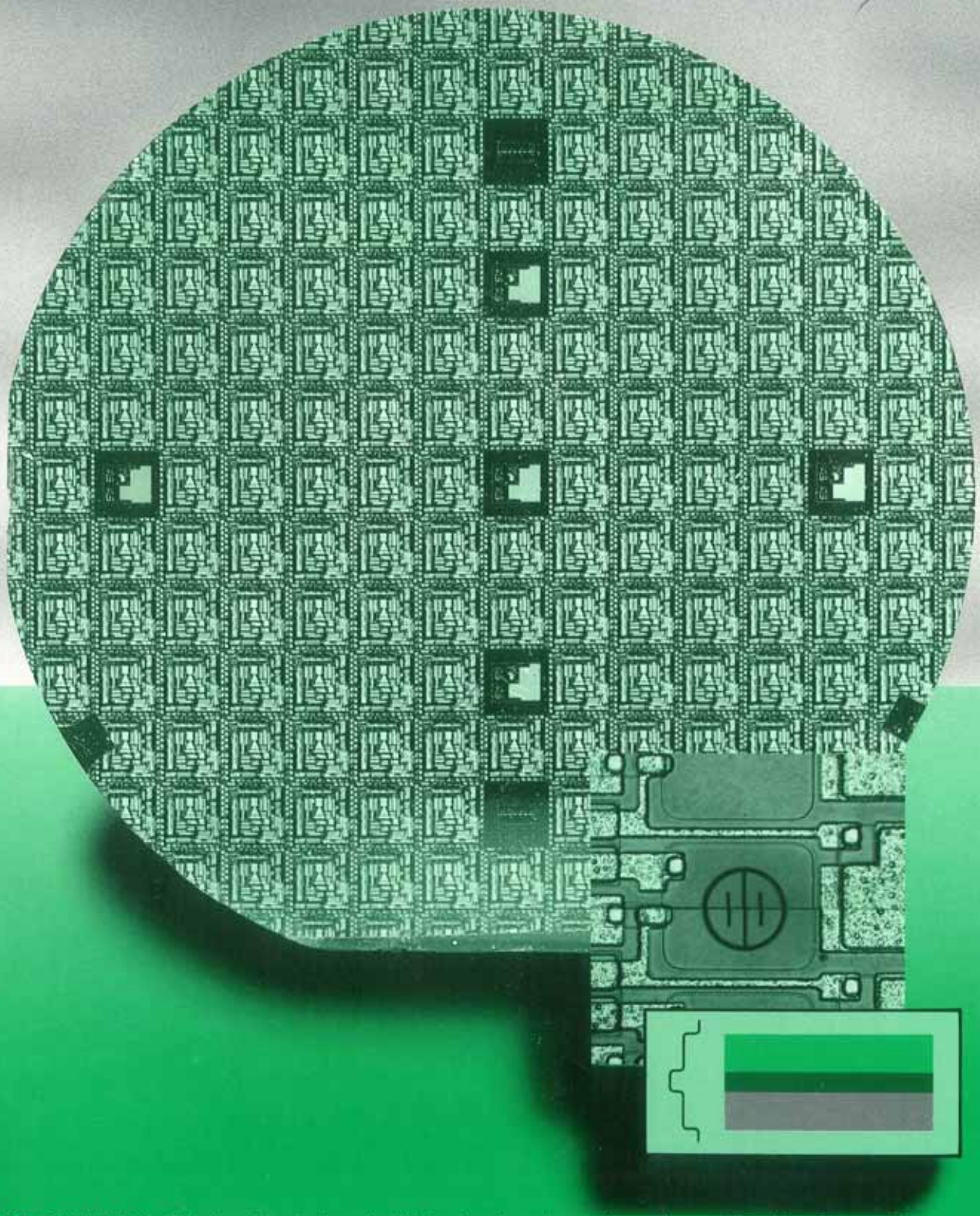


IMAGE SHEARING: Tried and tested and still the best and most precise method for the routine measurement of features on masks and wafers.

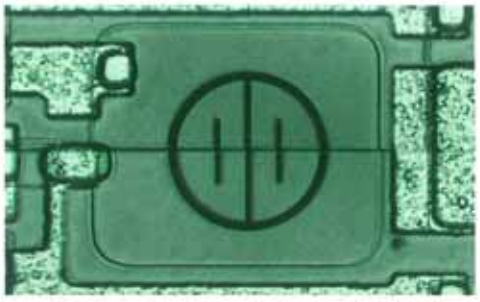
PRECISE MEASUREMENT OF FEATURES DOWN TO SUB-MICRON DIMENSIONS

M41 micromeasurement systems are designed to ensure that even inexperienced operators can achieve the extremely accurate and repeatable measurements required in today's Semiconductor Industry. By eliminating focusing errors with the Precise Focus Indicator and assisting image shearing setting using the light intensity profile display and 'strip shearing' methods, repeatabilities of better than 0.01 microns are readily achieved on features down to sub-micron dimensions.

PRECISE FOCUS

M41 Measurement Systems all include Bio-Rad's unique Precise Focus Indicator. An index grid may be switched in to appear through the eyepieces or on the monitor as a circle with a centre line and two short vertical lines to either side. If the image is slightly out of focus the grid appears divided across the centre. At true focus the lines are straight and continuous across the circle.

Precision of focus setting, even to the untrained operator, is of the order of one tenth of the depth of focus for the objective employed. For an objective of Numerical Aperture of 0.85 (e.g. the 80X Microplan supplied with the system) precision of setting, in green light, is 0.07 microns.



True focus

Slightly out of focus

IMAGE SHEARING

M41 Micromeasurement Systems all incorporate Bio-Rad's unique image shearing methodology, enabling the most accurate and repeatable measurements to be made. The image shearing module, positioned between the system objective changer and the viewing head, produces two identical images of the feature to be measured. By moving these images, one across the other, from an initial superimposed state until the image edges 'just touch', the size of feature is very accurately measured and the size, in microns or micro-inches, displayed on the digital read-out unit. An image rotation facility is included to ensure accurate alignment of the required feature dimension with image shearing direction.

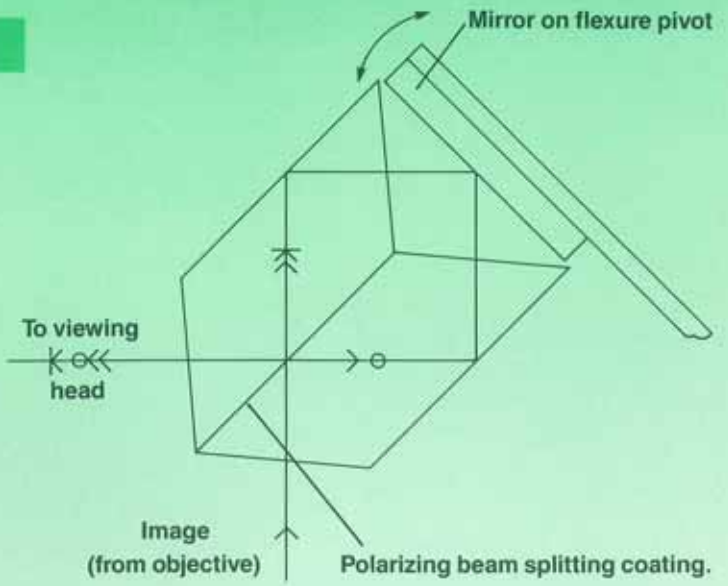
HOW IT WORKS

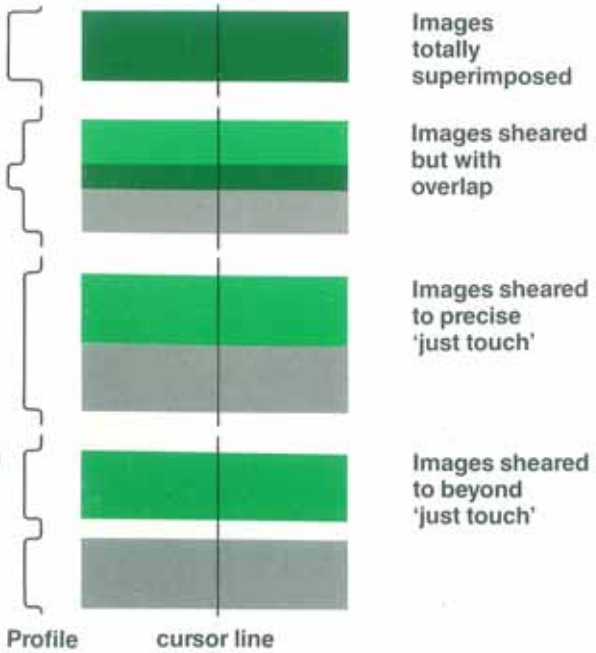
Light from the image enters a prism arrangement impinging on a polarizing beam splitter interface where it is orthogonally polarized. One beam is transmitted through the interface, the other totally reflected. Each beam follows a common, closed loop path, in opposite directions, via an external mirror and making either two transmissions or two reflections of the beam splitting interface.

The light emerging from the prism arrangement consists of two image beams which, when the mirror is perfectly normal to the beam splitter, will be completely superimposed. Image shearing is achieved by tilting the mirror which is mounted on a flexure. Movement of the flexure is very precisely monitored by a strain gauge bridge configuration. Thus the output of the bridge is a direct measure of the amount of image shear.

Once calibrated against standards provided with the system, feature sizes can be measured with extreme accuracy and repeatability. Because of the nature of the image shearing method measurements are much less susceptible to focus variation and vibration effects than other systems.

Unlike other systems, Image Shearing measurements are independent of video camera non-linearity.





INTENSITY PROFILE DISPLAY

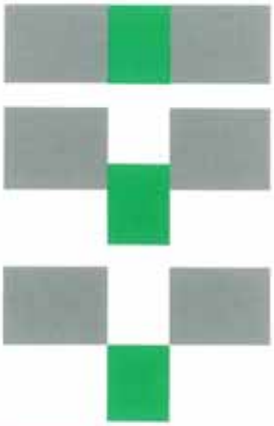
By displaying on the monitor a profile of the light intensity of the images as they are sheared, the sheared image 'just touch' position can be clearly defined from the profile. For images sheared to either side of 'just touch' a 'blip' or a 'dip' occurs in the profile whereas at 'just touch' the profile is smooth.

A user settable cursor line displayed on the monitor defines the image position to which the profile relates.

COINCIDENCE SETTING SHEAR (CSS)

OR "STRIP SHEARING"

As a further aide to judging 'just touch', especially useful with complex wafer images, CSS causes only the centre portion of the image to be sheared, allowing the extremely high vernier acuity of the eye to achieve extra precise setting. 'Just touch' is judged by detecting very small displacement of one part of a line relative to the rest.



Superimposed CSS images

Partially sheared CSS images

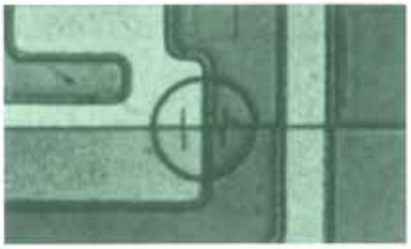
'Just touch' sheared CSS images

PRIME ACCESSORY FOR M41 MEASUREMENT SYSTEMS

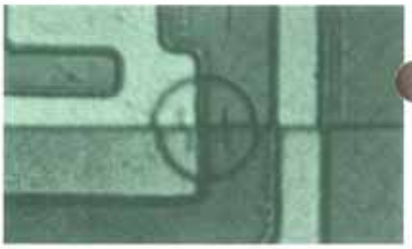
Z-AXIS MEASUREMENT

For extremely accurate and repeatable measurement of feature height, layer thickness etc, the Z-axis measurement option incorporates a highly sensitive strain gauge measuring unit and digital read-out, together with calibration standards.

Use of this facility with the precise focus indicator allows thickness measurements to be made up to 2mm with a resolution of 0.1 microns.



Focus on top of layer



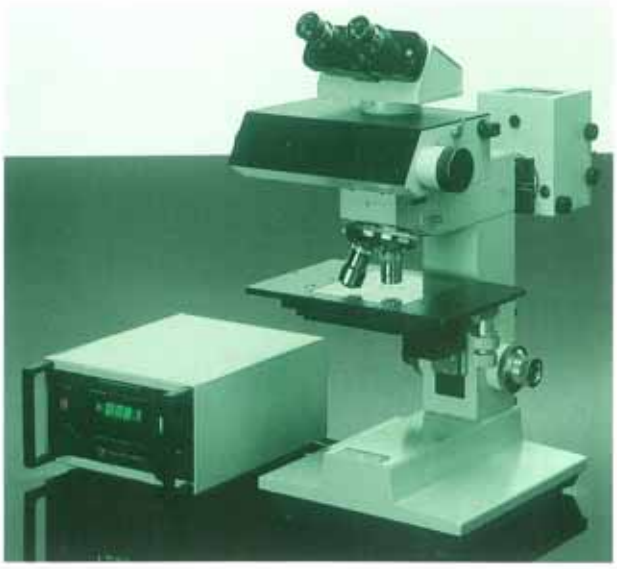
Refocus on substrate

Digital readout shows layer height

M17 MICROSCOPE

Another high performance microscope from Bio-Rad is the M17, available with or without image shearing. Note that the precise focus indicator is not available with the M17.

Ergonomic design combined with the high quality optics ensure that the M17 can be used for long periods without eyestrain or fatigue. Stage movements on the M17 is 4" ×4" and a simple package of M17 microscope with image shearing module and read-out unit offers an inexpensive option for micromeasurement in the more cost conscious laboratory.



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