OEG
Optik,Elektronik
& Gerätetechnik

FLATSCAN

Contactless measurement of

SURFACE CURVATURE
FLATNESS
THIN FILM STRESS

FLATSCAN is the ideal measuring instrument for research and development. It connects a highly exact measurement principle with a simple and flexibly usable structure. On the basis of most current software technology FLATSCAN both access to the raw data and numerous mathematical functions offers. By a wafer handling can be developed it to a manufacturing-suited measuring instrument and reaches a throughput of up to 60 8"-wafers per hour.

Optical measuring principle for surface curvature

FLATSCAN provides non contact measurement of flatness, waviness and straightness of reflecting surfaces of all kinds surfaces like
-silicon wafers
-glass substrates
-mirrors
-x-ray-mirrors (goebel-mirrors)
-metal surfaces
-polished polymers a.s.o..
The optical measurement principle ensures a high accuracy and high measuring speed. It is based on the automatic place-dependent measurement of the reflection angle of a perpendicularly on the surface incident ray of light. From the change of the reflection angle from measuring point to measuring point the surface form can be reconstructed computationally highly accurate.
In addition, for some applications the reflection angles themselves are from interest. Therefore the software offers the possibility of accessing also the angle values themselves.

Large measuring field

A special characteristic of the assigned measurement principle is its independence from the measuring field. Thus the standard measuring field diameter (250mm) is nearly arbitrarily expandable. It is particularly remarkable that even for large measuring fields no losses develop regarding the measuring accuracy.

High accuracy

FLATSCAN is characterised by a high measuring accuracy. The resolution of the standard measuring system amounts to 0.1 arcsec. This guarantees with which a accurracy for surface curvature measurement of 100nm.
Measuring systems with higher resolution are available, but only used on customer demands. Thus the accuracy can be improved further.
Because of the high accuracy in connection with the large measuring field and the large measuring range FLATSCAN offers completely new possibilities to solve difficult, until today unsolvable, measuring tasks.

Large measuring range and high work distance

The measuring range is the maximum arrow height, which can be measured during one scan. FLATSCAN offers a very large measuring range. In connection with the high accuracy and the large measuring field completely new measuring tasks can be solved.
One example is measurement of x-rax-mirrors, which cannot be measured with conventional measuring principles (like fringe- or phase-interferometers) because of the strong surface curvature. Another application are silicon wafers (with and without thin films). The measuring principle works independent from the working distance and needs no autofocus. The free working distance is minimum 100mm and can be increased on demand.
The measuring range depends from measuring field and is shown in the technical parameters and table1.

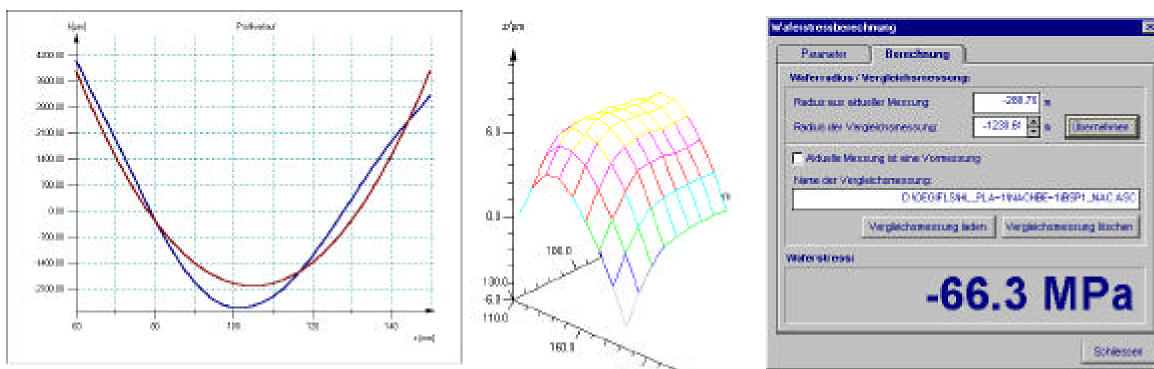
Scan length	Measurable arrow height	Related surface curvature
50 mm	72,5 µm	4,31 m
100 mm	145 µm	8,62 m
200 mm	290 µm	17,24 m
300 mm	435 µm	25,86 m
500 mm	725 µm	43,10 m

Table1: Measuring range of FLATSCAN

Optional 2D- or 3D-Measurement

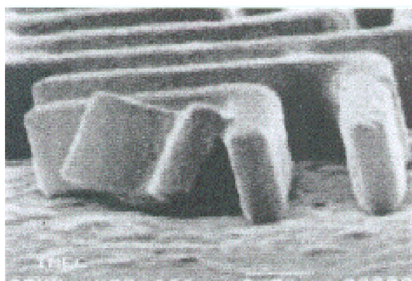
Optional, in dpendence from the device type, single scans or complete 3D-scans can be measured. The measurements are automatic, software controlled. The software offers numerous functions for graphical and numerical data evaluation as well as the raw measuring data if needed.

Additional software modul for thin film stress measurement



Measurement of 2D/3D surface curvature, with additional software modul for thin film stress measurement

FLATSCAN provides fast, automated monitoring of thin film stress during processing of semiconductor wafers up to 300 mm diameter. For use in semiconductor technology the software offers a modul for computation of thin film stress (using the theorie from Fowkes) from the measured surface curvature or their changings after a processing step. The stress of a thin film (or multiple thin film stack) is determined by measuring the change in the radius of curvature (R) of a substrate (usually a thin film) due to the deposition of the film.



For accurate determination of the film stress, the curvature of the substrate must be measured both with and without the film. In some cases (e.g., films deposited on bare silicon wafers) the curvature of the substrate can be assumed to be infinite.
The technique requires that the thickness of the substrate and the thickness of the film be known.
The thickness of the sample is not limited. Measuring time including setup, for single curvature measurements is about 2 minutes. The results of measurement are available immediately after conclusion of the measurement. Any measuring data can be combined for stress computation.
The minumum radius (R) which can be measured, is 17 meters for 200mm scan length for the standard device (the more highly stressed the film, the smaller the radius). The measurable radius can be made smaller by use of another optics. FLATSCAN can nominally measure curvature in wafers with near zero stress. FLATSCAN can measure to within .00027 degrees across a wafer. This translates to a minimum stress of 0,5 to 5 MPa.
FLATSCAN has a typical one sigma error in 1/R of 1/4000 meters. This translates into 2 MPa for a one micron film on a 525 micron silicon wafer. Thicker films/thinner substrates reduce the errors (and vice versa).

For thin film stress computation any measured surface curvature values can be combined. Beside the thin film stress computation the software includes numerous options for data operations. The measuring process is fully automated and software controlled.

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Technical Parameters

Standard device

Parameter	FLATSCAN 200 / 300
Accuracy surface curvature	≤ 100nm**
Accuracy thin film stress	2 Mpa (525µm substrate, 1µm film)
Minimum measurable thin film stress	0,5 ...5 MPa
Resolution of optical measuring system	0,1 arcsec
Specimen thickness	not limited
Step width	1mm (down to 0,1 mm possible)
Measuring speed	10mm / sec ... 30mm/sec.
Measuring field	∅ 300mm * (more than 300mm on inquiry)
Minimum radius R of surface curvature and belonging arrow height in dependence from specimen diameter	50mm: R=4,5 m 72,5µm 100mm: R=9 m 145 µm 200mm: R=18 m 290 µm 300mm: R=25m 435µm 500mm: R=43m 725µm
Free working distance	minimum 100 mm * (nor limited)
Measuring wavelength	670nm* and 550nm*
Spectral measurements	any measuring wavelength possible
Autofocus	not necessary
Automatic measurements	yes
Manual measurements	possible by joystick
Operating system	Windows95/98/NT/2000/XP
Software	32 Bit
Stepping motor controller	1- or 3-axis controller (depends from device type)
PC	minimum Pentium III, 128 MB RAM, 32 MB VGA

* Technical parameter of standard version, can be adapted to customer demands

**Standard deviation of 50 repeating measurements of the same Scans

FLATSCAN HR (Only the differences to the standard device are specified

Parameter	FLATSCAN
Accuracy surface curvature	≤ 20nm**
Resolution of optical measuring system	0,01 arcsec
Step width	1mm
Measuring speed	10mm / sec

** Standard deviation of 50 repeating measurements of the same Scans

Technical specifications subject to change without notice