NON-CONTACT
3D SURFACE METROLOGY

Laser Marking Measurement
INTRODUCTION

One of the last steps in the production of electronic components is the laser marking process. Manufacturer logos, part numbers and other product specific characters are applied on each component using a laser.

The laser removes tiny layer material from the molded surface and thus changes the texture of that surface. This makes the mark visible for the human eye as well as for machine vision. The molding has often less than 100 µm thickness above the silicon die inside the package. It is instrumental that the laser ablation process is well controlled, as an uncontrolled process could damage the die inside the package. At this process step most of the value is already added, failures are expensive and greatly affect the yield.

TECHNOLOGY OVERVIEW

Microscopes and camera systems measure the width, the position and other x-/y- dimensions of the laser mark. The most important information for effective process control is the depth of the laser ablation. The molding itself typically shows a high surface roughness. This fact makes it difficult to use an optical focus technique for measuring the ablation depth. An appropriate 3D technology must be able to use the molding surface as a reference plane and the mark itself for measuring the depth of the ablation. Also 2D profilometers or 3D systems without vision capabilities are not well suited, because it is difficult to detect the laser scribing on the rough molding surface. Traditional 2D or 3D edge detection algorithms cannot differentiate between surface roughness and laser scribing.
A 3D map outlines the problem to define the scribing using 3D data only.

The optimal solution for measuring laser marks is a combination between 2D vision technology and 3D profiling!
LASER MARKING WIDTH AND DEPTH MEASUREMENT

The SCAN CT Software provides all the necessary analysis for measuring the width and depth of the laser mark. System control and data analysis are integrated in one user-friendly interface.

For ease of use, the system provides a live video image and the navigator to move the sample to the area of interest. As soon as the laser mark is positioned roughly in the middle of the live video a click on the start button initiates the measurement cycle. Before the actual measurement starts the user can be requested to fill in SPC relevant data like part number, machine ID, laser head etc..

After starting the measurement, the image analysis finds the laser mark within the field of view. Advanced pattern recognition algorithms detect the laser mark even though the edges are not clearly defined and the mark still contains dark areas from the molding that have not been ablated by the laser.
The purple polygon shape within the red cursor clearly marks the laser scribe and the width is measured automatically. The analysis is displayed as small lateral dimension and works in any orientation, so the user does not need to indicate if the laser mark is horizontal or vertical.

After finding the laser mark within the field of view, the cyberSCAN VANTAGE starts to scan the red area. With a lateral resolution of 5 microns the scan is finished within 30 seconds.

The shape of the laser mark calculated in the video analysis is now projected into the completed 3D raster and used as a 3D measurement cursor. Only within the red area the average depth and the maximum depth are measured.

After finishing the measurement at one position the user continues with the next position or ends the measurement cycle. Data are saved and can be loaded in any type of CAQ or SPC software for further analysis.
CONCLUSION

The cyberSCAN VANTAGE with the new macro optics camera offers sophisticated laser mark measurements. With its unique dual analysis technology greatly improves process control capabilities and ensures high yield at this vital process step.

For more information on cyberTECHNOLOGIES’ suite of 3D surface metrology systems please contact us at info@cybertechnologies.com.
The cyberSCAN VANTAGE 2 is a non-contact surface metrology system. It combines high resolution confocal sensor technology with a x- and y-translation stage. The system can measure large areas up to 200 mm with maximum x-, y-, z-resolution. All electronic components are integrated into a robust housing, no cables or external controllers are required. The system is connected with a single USB cable to PC or workstation. The proprietary and user friendly cyberTECHNOLOGIES Software offers sophisticated surface metrology analyses and automated measurement routines.

**APPLICATIONS**

Typical applications for the cyberSCAN VANTAGE 2 are the analysis and quality control of printing processes, such as thickfilm measurement on ceramic or any other substrates, PV solar cells, volume measurement of paste depots, epoxy-film, dots or other printed and dispensed features. Geometry and position measurement of highly contoured objects like solder bumps, MEMS devices, as well as flatness and coplanarity analysis are other popular applications.

- Printed products, systems or devices
- Device packaging, BGA bump height
- MEMS
- Solar and fuel cell elements
- Soft and transparent materials or coatings
- Medical devices
- Ceramics and plastics

**SOFTWARE**

The proprietary cyberTECHNOLOGIES Software package SCAN SUITE combines system control, data collection and data analysis in one user friendly interface. Comprehensive profile, 3D and roughness analyses conforming even to the latest DIN ISO 25187 are included. The Software can handle up to 100 million data points and takes advantage of the powerful Windows 7 64-bit platform.

An outstanding feature is the ASCAN Software. No programming skills are required to create even complex programs in a few minutes:

- Automation of measurement routines
- Easy programming using tasks and templates
- Offset and fiducial correction using pattern recognition
- Built-in SPC Charts with reporting function
- Flexible, user defined data output format
- Barcode or user field input
- Step & Repeat function

**TECHNOLOGY**

- Chromatic confocal sensors
- Resolution down to 0.02 µm, measurement range up to 10 mm
- Lateral resolution 1 µm
- x/y - stage with reliable and precise controls
- 200 mm travel in x- and y-direction
SYSTEM INCLUDES

- cyberSCAN VANTAGE 2 base unit with manual z- and motorized x- and y-stage
- One chromatic confocal sensor of choice
- State-of-the art PC with installed Windows 7 64-bit and cyberTECHNOLOGIES SCAN SUITE license

OPTIONS

- High resolution off-axis color camera with illumination and calibrated crosshair
- Mono-chromatic confocal sensor for solar applications and measurement on anti-reflective coatings
- ASCAN Software
- Calibration and certification targets
- Motorized z-axis with autofocus function

SPECIFICATIONS

- **DIMENSIONS**
  - (L X W X H) 940 x 580 x 530 [mm]
  - (37 x 23 x 21 [in])
- **WEIGHT**
  - 71 kg (156 lbs)
- **SYSTEM CONTROLLER**
  - PC (inquire about actual configuration)
  - running Windows 7 64-bit
- **POWER REQUIREMENTS**
  - 100-240 V AC, 50-60 Hz, 2.0 amps (240V), 5amps (100V)
- **OPERATING TEMPERATURE**
  - 20°-30° C (68–86 F)
- **MEASUREMENT SURFACE SIZE**
  - 305 x 305 [mm]
  - (12 x 12 [in])
- **MINIMUM LATERAL RESOLUTION**
  - 1 micron
- **TRAVEL LIMITS IN X AND Y (MOTORIZED)**
  - 200 x 200 [mm]
  - (8 x 8 [in])
- **TRAVEL LIMIT IN Z (MANUAL)**
  - 40 mm (1.6 in)
  - (adjustable height levels and micrometer fine adjustment)
- **MAXIMUM LOAD ON PLATFORM**
  - 6.8 kg
- **THROAT DEPTH / THROAT CLEARANCE**
  - 330 / 250 [mm] (13 / 10 [in])
- **AVAILABLE SENSORS**
  - Chromatic Confocal Sensors (CHR)
  - Blue Laser Confocal Sensor (LT-9510)
APPLICATIONS

BUMPS
Bumps normally consist of highly reflective material and are difficult to measure for an optical system. Especially the edges can be a problem for traditional 3D-systems and only a small area in the middle of the bump is detected. cyberSCAN benefits:
- Effective technology for measuring true bump shape
- Accurate measurement of bumps and components, including coplanarity, height, volume, diameter and position

THICK FILM
Controlling the thickness of various print layers on hybrid substrates is essential because electrical parameters are directly related to the thickness. cyberSCAN benefits:
- The non-contact measurement technology measures the wet sample immediately after the print
- Automatic measurement routines create repeatable and user independent results

FLATNESS
Flatness measurement is required for a lot of components including wafers, optical and mechanical parts. cyberSCAN benefits:
- Accurate measurement of flatness even on large and highly contoured parts
- Effective methods for removing edges and defining target areas

TRANSPARENT FILM AND COATINGS
Transparent films or deposits such as flux or epoxy are difficult to qualify and quantify. Certain materials are invisible for microscopes or AOI systems.
- Accurate measurement of transparent deposits and films, including height, area and volume as well as length, width and position
- Effective technology for detecting different surface levels

SOLAR
The front side metallization is a sensitive printing process. In-line camera systems can only inspect 2D data. To set-up and optimize the printing process true 3D data is required. cyberSCAN benefits:
- A blue laser sensor can collect data from texturized and coated solar cell surfaces
- Edge detection algorithms measure finger height and width

SURFACE ROUGHNESS
Measuring roughness on highly contoured or pliable surfaces is difficult using a tactile stylus system. cyberSCAN benefits:
- Non-destructive and fast roughness measurements
- All analyses are conforming to DIN ISO standards, tactile probe tip simulation software
SCAN SUITE 8

SCAN CT - PROFILE AND 3D ANALYSIS SOFTWARE

SCAN CT is a software package for measuring and analyzing 2D profiles and 3D raster maps. It offers complete 2D and 3D surface measurement parameters as well as sophisticated filter and compensation methods. All combined in an operator friendly user interface.

2D PROFILE MEASUREMENTS
- Step Height (avg., max. and min. height)
- Flatness and Warpage
- Width and Length
- Cross Section Area
- Angle, Radius, Contour Analysis

Define base line and measurement areas using reference and measurement cursors. Select analysis from dropdown menu.

3D COPLANARITY MEASUREMENTS
- 3D Height (avg., max. and min. height)
- Flatness and Warpage
- Coplanarity

Draw rectangle, round or polygon cursors to define base plane and measurement areas.

PROFILE ROUGHNESS MEASUREMENTS
- DIN EN ISO conform Roughness Parameters
- Shape Removal Algorithm
- Abbott-Firestone Material Curve
- Histogram
- Tip Simulation for Non-Contact Systems

Advanced roughness analysis, even on round or angled surfaces using shape compensation. Display waviness and roughness profile.

3D VOLUME MEASUREMENTS
- Volume (Cuts, Fills, Net Volume)
- Planar area
- Surface area

Measures cuts and fills and uses height threshold. Accurate areal and planar surface calculations.

3D SURFACE MEASUREMENTS
- 3D COPLANARITY MEASUREMENTS
- 3D VOLUME MEASUREMENTS

Download your free trial today for a 30 day complimentary test drive at scanctsoftware.com.
**PARALLEL DATA COLLECTION**
- Parallel scanning with up to 4 sensors
- Collect Top, Bottom and Thickness data
- Average Thickness, Bow and Curvature
- Total Thickness Variation
- Parallel Intensity Masking

**3D ROUGHNESS MEASUREMENTS**
- New DIN EN ISO 25178 Parameters
- 3D Waviness Filters
- 3D Abbott-Firestone material curve, Histogram

**2D AND 3D SURFACE COMPENSATIONS**
- 2D and 3D Polynom Fit
- Pre- and after measurements
- Areal Waviness Compensation

**MORE FEATURES AND HIGHLIGHTS**
- x-, y-, z-data stitching capability
- 2D and 3D edge detection algorithm
- Windows 7 64 bit Version available
- Raster up to 200,000,000 data points
- Integrated user management

**SUMMARY**
SCAN CT is a complete, unique and easy to use surface analysis software. It offers outstanding features and includes the following highlights:
- Complete 2D and 3D surface analysis
- Profile and 3D roughness measurements according to DIN ISO EN Standards
- Comprehensive profile and surface compensations
- Advanced filter technologies
- Uni- / bi-directional scanning
- Linear, circular and ellipsoidal scanning
- Simultaneous data collection of up to 4 sensors
- Dedicated user management
- Up to 200 Mio. data points per raster
- Fast multithread technology
ASCAN 8

AUTOMATIC PROFILE AND 3D MEASUREMENT SOFTWARE

ASCAN 8 is a software package for creating automated 2D profile and 3D raster measurement routines. This allows the cyberTECHNOLOGIES VANTAGE and CT SERIES to be used in production. Measurement data are collected fast and without user interference for maximum repeatability.

AUTOMATED MEASUREMENT PROGRAMS
- Easy to use menu based software tool
- No programming skills required
- Automated data analysis without user interference
- Ideal for use in production or laboratory

INTEGRATED SPC AND DATA LOGGING
- Define warning and failure limits
- Clear Good / Bad / Warning indication
- View X-bar / R SPC graphs
- Print report function with charts
- Advanced statistics

Multiple results per position, switch between box view and table view.

Flexible data output via file or web-service for easy integration into existing CAQ software

Sample file in csv format for use in MS Excel

FIDUCIAL CORRECTION
- Part offset and rotation compensation
- Manual and automatic mode
- Scan definitions follow part rotation

Live video and calibrated crosshair on a hybrid circuit

2D PROFILE TASK
- Define analysis and scan setting
- Save task to database and update from database
- 2D edge detection with or without template

2D task template with search areas for 2D edge detection
**VIRTUAL TASK**

- Use virtual task to link existing results
- Create custom design analysis
- Easy to use mathematical editor function

**SPECIAL SETTINGS**

- Output surface maps and contours automatically
- Integrated user management
- Enter comments in SPC data

**USER FIELDS**

- User field entries before or after program start or at defined conditions
- Accepts bar code or data matrix entries
- Automatic program search
- Filter SPC data based on user fields
- Data traceability
- Enter numeric values for calculations in virtual tasks

**SUMMARY**

**ASCAN HIGHLIGHTS:**

- Software tool for measuring 2D profiles and 3D raster automatically
- Easy to use, menu based software, no programming skills required
- 2D and 3D edge detection algorithms
- Clear good, bad and warning indication
- Built-in SPC charts with reporting function
- Easy programming using tasks and templates
- Integrated database for tasks
- Offset and fiducial correction
- Table view for multiple results
- Flexible, user defined data output format
- Barcode or user field input
- Step & Repeat function
- Plug-Ins for customized software solutions

**STEP AND REPEAT**

- Easy program setup using step and repeat
- Designer for multiple levels
- Activate / deactivate individual offsets

**3D RASTER TASK**

- Multiple cursor sets per scan
- 3D edge detection and correlation algorithm
- Template fiducial for easy position teach-in

**3D images of 9 positions on a solar cell**