Application Note RSMD-20104496

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Defect sizing and identification using 3D and XRF review

WLP bumping / device wafer

Introduction

The Onyx hybrid configuration (X-ray analysis, 3D scanner and 2D microscope) provides detection and metrology solutions integrated in a single tool while obtaining precise and stable measurement of a wide range of features, shapes and materials, creating an improved cost-effective in-line defect-detection and metrology solution.

Innovative image acquisition technology and image processing algorithms enable Onyx tools to achieve better detection capabilities.

Onyx tools have the unique ability to detect defects and processing errors and to complement with in-depth metrology analysis to characterize process outputs, including quantitative analysis of color defects, missing or varied layers, and variation in the shape or position of geometric features.

Magnification: X2

Magnification: X10

Magnification: X50

2D microscope imaging

- Full-wafer scan was performed by the 2D microscope
- Large contamination / defects were chosen to demonstrate the capabilities of the Onyx tool
- After contamination is detected using the 2D microscope, the 3D scanner measures its height profile and surface

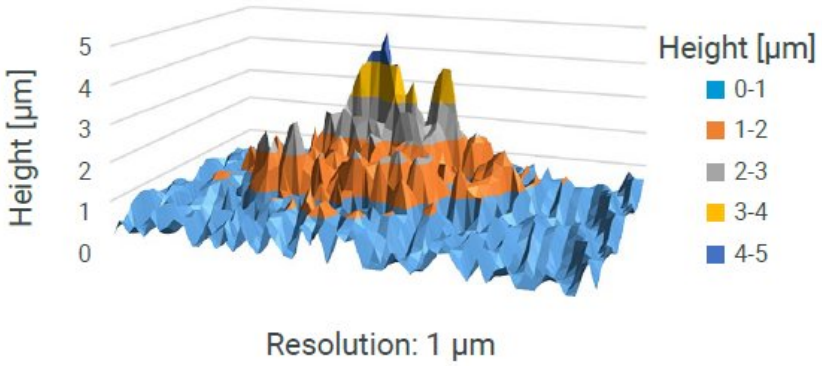
Measurement objectives

The main interest in this WLP (wafer-level packaging) application is to differentiate killer defects through the use of contamination detection and height measurement. Using the Onyx tool, it is possible to scan the wafer with the 2D camera and segregate large contaminants using pattern recognition. The contaminants beyond a set size are potential killer defects due to their height. With the 3D scanner, this can be verified.

3D Height scan

- The contamination area was scanned by the 3D scanner to identify height changes.
- Surface roughness is ~1.3 µm Ra.
- The contamination maximum height is 4.5 µm.

Height scan



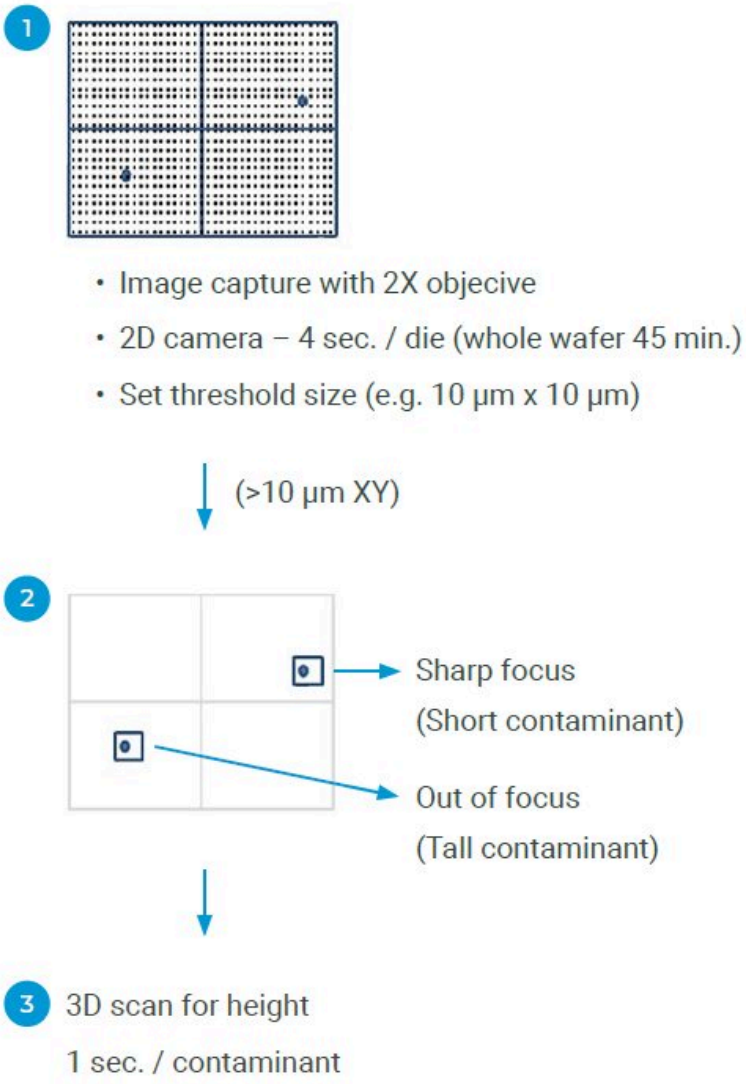
XRF material scan

The contamination found by the 2D microscope can be reviewed and analyzed using XRF.

Time

	Title	Full Wafer	Half Wafer	10% Wafer
1	2D – 2X objective inspection	45 min.	25 min.	8 min.
2	2D – 10X objective inspection	1 sec. / particle (>10 µm x 10 µm)	→	
3	3D – scan height meas.	1 sec. / particle (Out of focus)	→	

Workflow



Summary

The 2D microscope can be used to detect contaminants on the wafer and their critical dimensions using the image processing tool. For further analysis, the 3D scanner can be used for height measurement of the contamination. The above two applications were developed per customer requirements. Application performance can increase dramatically once the requirements are further defined.

Related products

ONYX 3000

EDXRF and optical hybrid metrology tool for automated X-ray analysis, 3D scanning, and 2D microscope for film thickness and composition measurements on blanket and patterned wafers for up to 300 mm wafers