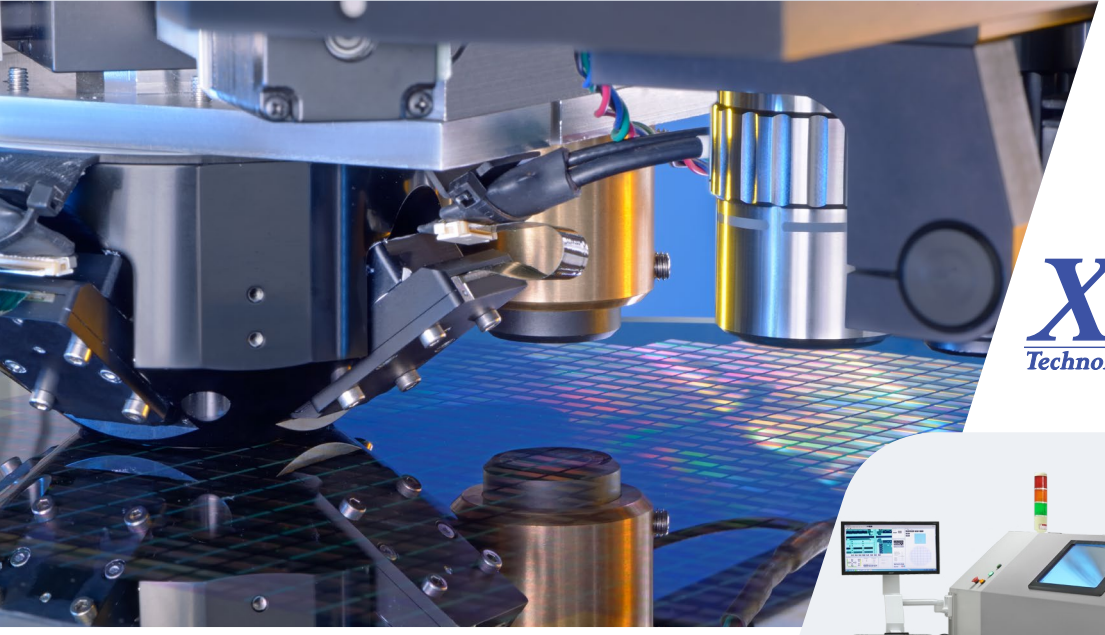

XwinSys Technology Development Ltd.

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APPLICATION NOTE

Single Wafer Pass - Detection & Metrology of Features

Introduction: In-Line Single wafer pass capability of detecting and analyzing process issues provides a cost effective method implementing a hybrid metrology sensor capability.
Detection and analysis with a small beam spot are done in concert, on one system is XwinSys competitive advantage. XwinSys offers a cost-effective solution, while maximizing data generation and minimizing wafer handling risks.

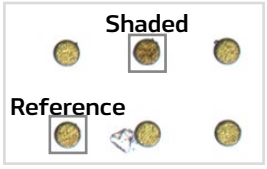
Problem statement: Find a method of rapidly detecting and analyzing thin film issues on small area features, preferably in a single wafer pass. Typically, this task would involve in-line and off-line analysis tools and a large amount of time to perform which would interrupt the process flow, making it not feasible in a production environment.

Offered Solution: The XwinSys ONYX system uses a highly sensitive color 2D camera to qualitatively find evidence of a film issue on a feature, detecting an anomaly which can then be reviewed with an XRF rapidly to quantify the issue.

UBM (under Bump Materials) defect detection and composition analysis

Objective: Detection of defected UBM (Under Bump Materials) by full wafer scan with 2D microscope using color image processing and further XRF analysis for elemental composition to conclude and monitor process.

2D Microscope Defect detection: Image processing algorithms analyzed each frame to detect color defects. Reference color levels were set and gray level analysis was performed on each image; the following values were received: **2D acquisition time 1 sec. per frame**.



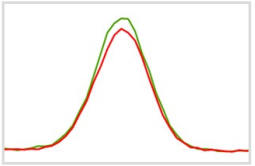
Magnification: X10

UBM	Grey Level
Shade	109.6
Reference	152.9

Black = 0; White = 255

XRF Metrology: Suspected detected UBM defects are automatically delivered for XRF analysis of Au (Gold) thickness, monitoring Au variation in high sensitivity.

XRF Analysis measurement, presents a **gap of 13% Au thickness** in the dark coloured UBM. This finding matches the grey level results and demonstrats a significant process deviation.
XRF acquisition time of 25 sec. per site



Reference dot thickness
Shaded dot thickness

Sample	Normalized Intensity
Shaded dot	86.8%
Reference dot	100%

Single Wafer Pass - Detection & Metrology of Features

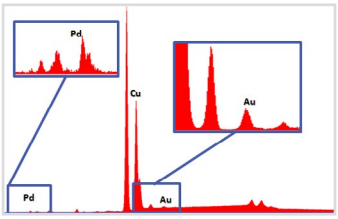
"Dark" & "Light" Colored Pads detection, Comparison and material analysis

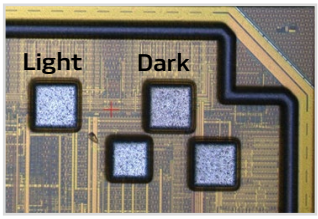
Objective: Identify defective pads by scanning a full wafer with the 2D microscope and analyzing those pads which deviate from a set grey level with ED-XRF for elemental composition differences. Once pads were inspected and analyzed for grey levels, the XRF capabilities were applied to perform material analysis and to quantify the differentiation between the dark pad and the light pad.

2D Microscope Defect detection: Color differences were quantified by the Image Processing S/W. Different color pads were distinguished as "Light" & "Dark", RGB values were analyzed.

Acquisition time: 2D acquisition time 1 sec. per site.

Pad	Red	Green	Blue
Dark	152	157	194
Light	181	212	141





XRF Metrology: Both layers thickness and composition were measured with a single XRF acquisition. Element compositions of: Au (L), Pd (L), Ni (K), Cu (K) were differentiated on the "Light" and "Dark" pads.

XRF acquisition Time 10 sec. per site

Element	Au (L)	Pd (L)	Ni (K)	Cu (K)
Difference	11.3%	8.3%	0.2%	2.35%

Fluorine on pad analysis

Objective: Scan and detect unwanted residuals on bond pads (fluorine in this case) using a highly sensitive 2D color camera followed by a light element ED-XRF analysis verification of suspected pads.

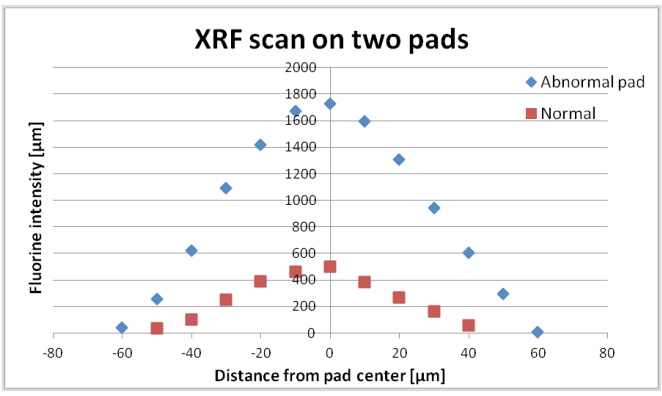
2D Microscope large area sampling of pads on each wafer (1 sec per pad) which detects out of spec grey levels.

Light Element ED-XRF detectors and helium purge of the air on the wafer are employed when revisiting suspect pads using a 20um diameter beam and analyzing for fluorine content.

XRF acquisition time: 14 sec. per site
It can be seen from the XRF scans that the fluorine levels in the suspected pads are significantly higher than in the normal pads. The Fluorine intensity level in the abnormal pad is 3.5X the level in the normal pad.

XRF can detect and quantify levels of Fluorine in a specific pad. From the results below all pads contain various levels of Fluorine. The pads with the higher level of Fluorine (X3.5) can be detected using highly sensitive 2D imaging grey levels.

Using the hybrid sensor inspect and review method, scanning all pads on the wafer can be done in less than 4 minutes. Failure analysis will be performed by XRF. Any combination of 2D sampling and XRF threshold analysis is recipe driven.



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