PHYSICAL ELECTRONICS

Application Note

Characterizing Bumped Wafers with the Quantera Scanning X-ray Microprobe

Introduction

Flip chip technology relies on wafer level "solder bumping" for die-to-package interconnect. One common method of bump deposition is as solder paste which forms 100 – 150 µm diameter bumps during a subsequent reflow heating step.

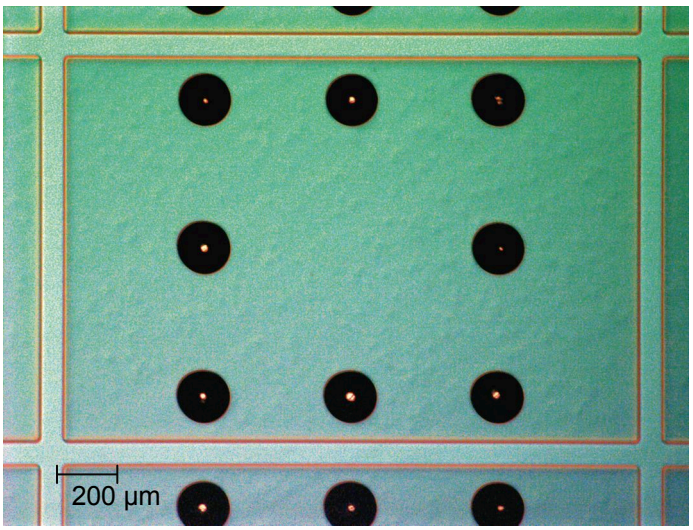
Deposition and reflow of a paste presents the possibility of solder contamination of areas on the die adjacent to the bumps. The 9µm diameter scanned x-ray probe beam of the Quantera SXM allows automated characterization of the surface composition of both the solder bumps and the interbump region of the die by X-ray Photoelectron Spectroscopy (XPS).

Surface Composition (Atom %)		
Element	**On Bumps**	**Off Bumps**
Lead	9.1 ± 1.6	2.0 ± 0.3
Tin	20.9 ± 1.4	0.2 ± 0.1
Lead/Tin	0.45 ± 0.09	10.5 ± 5.2

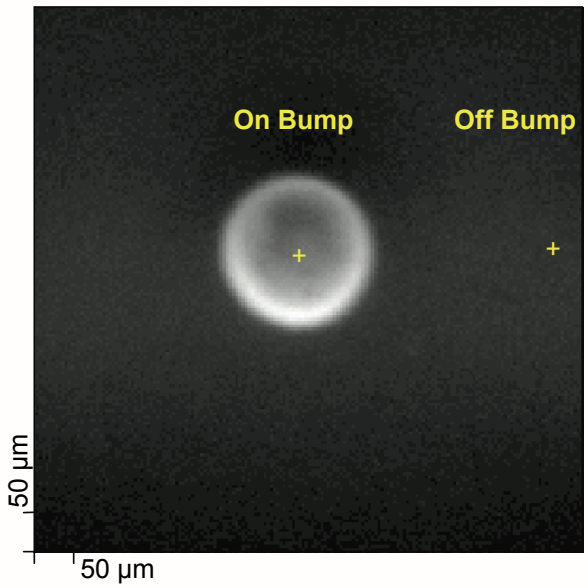
Micro-Area Spectroscopy

Using the SEM-like capabilities of the Quantera SXM, ten solder bumps were selected from ten die on a bumped wafer. Analysis locations were defined on and off of solder bumps using secondary electron images created by the scanned x-ray beam. A quantitative summary of the analysis is given in the table above.

XPS spectra collected on and off solder bumps showed that the die surface was contaminated by high levels of lead, presumably from the solder paste reflow process. The surface composition of the bumps was uniform over a large area of the wafer.



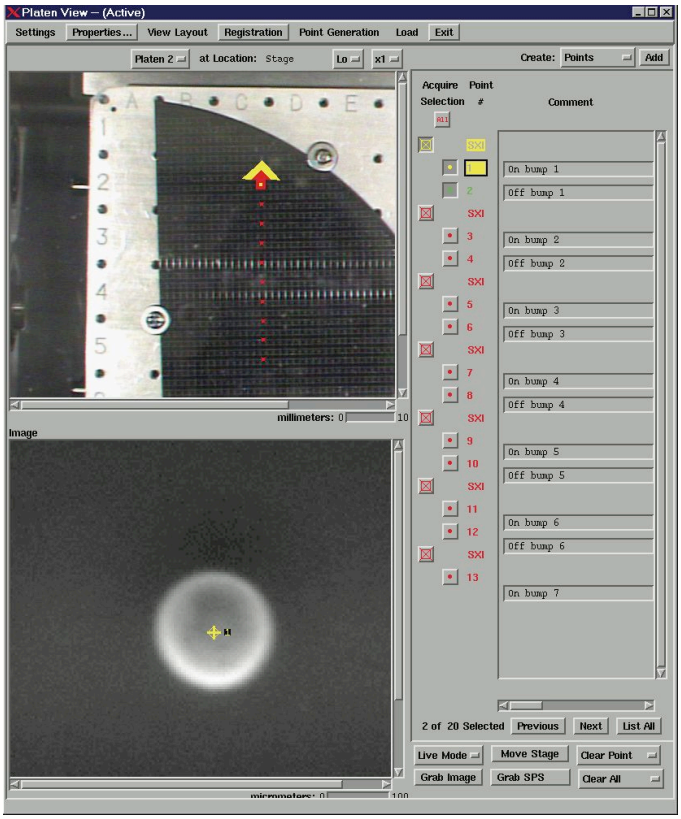
Optical image of solder bumps on a wafer (1072 x 812 µm) obtained with the Quantera's sample positioning station



Scanned x-ray beam induced secondary electron image of a solder bump taken by the Quantera SXM

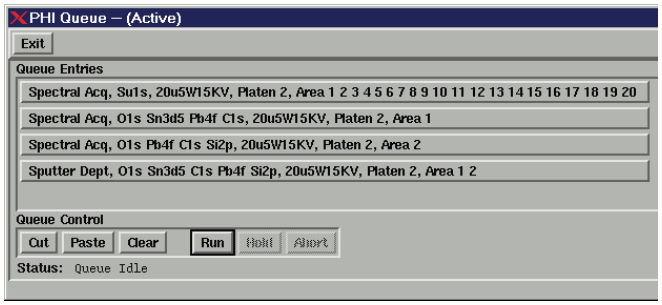
Automated Multi-Area Spectroscopy

The Platen View menu illustrates the navigation tools used to define multiple areas for analysis. The low magnification optical image (platen photograph) shows the location of ten secondary electron images. In each image two analysis points have been defined (on and off of a solder bump).



The Platen View menu provides a point and click interface for analysis area definition from optical, secondary electron and XPS images.

Any or all of the defined analysis areas can be selected for a specific analysis. With a single key stroke an analysis task can be added to an analysis "Queue" for unattended automated analysis. For this work multiple tasks were defined to: collect survey spectra from 20 locations, collect high resolution spectra from a solder bump, collect high resolution spectra off the solder bumps, and collect sputter depth profiles on and off of a solder bump.



The Quantera's analysis "Queue" allows multiple analysis tasks to be easily setup for automated analysis

Summary

The Quantera SXM has unique capabilities that allow multiple micro-areas to be accurately defined and queued up for automated XPS analysis. In this example a 20 µm diameter x-ray beam was used to analyze on and off of 10 solder bumps. The data showed the surface composition of the solder bumps to be uniform and that a lead rich solder residue was present on the wafer surface.

Quantera Scanning X-ray Microprobe

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