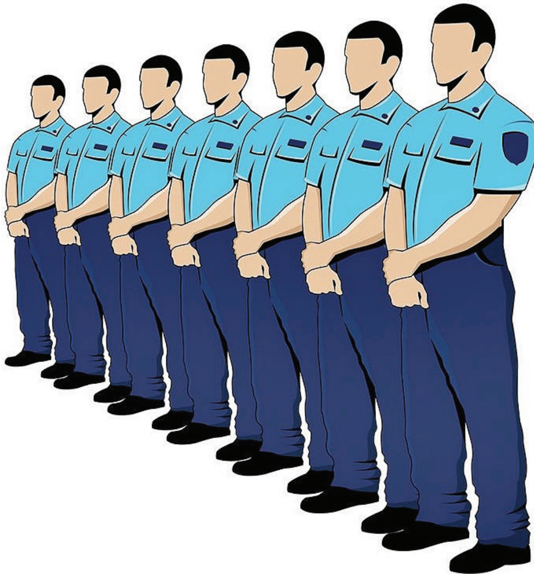
MACRO INTELLIGENCE

Insights for Increasing Yield and Reliability through Smarter Macro Defect Inspection #3

A Technical Bulletin from Microtronic – the Industry Specialists in Macro Defect Inspection

How "guardbanding" of inline wafer defects can improve chip reliability insurance

Removing more questionable die



In previous bulletins we discussed the problem of partially-defective, marginal die that are still functional enough to pass final electrical test. Some of these “walking wounded” chips get past final testing, but in the customer's end product, under ongoing stress, they may fail. This is a particularly serious issue with automotive, medical and other customers who demand maximum long-term device reliability.

The semiconductor industry has long used a process known as digital guardbanding to ink-off suspect die. This updates the die coordinates on the wafer map preventing shipment of suspect die. Guardbanding removes marginal die and also takes out additional die around the edges of clearly identified defective die, this added insurance is known as a “buffer."

To accomplish this, neighboring-die algorithms may be used to automatically search wafer maps and apply guardbanding based upon proximity to known bad die. For example, in Image 1 below, guardbanding might have been used to remove the questionable “good” area (indicated by arrow) within the scratch zone.

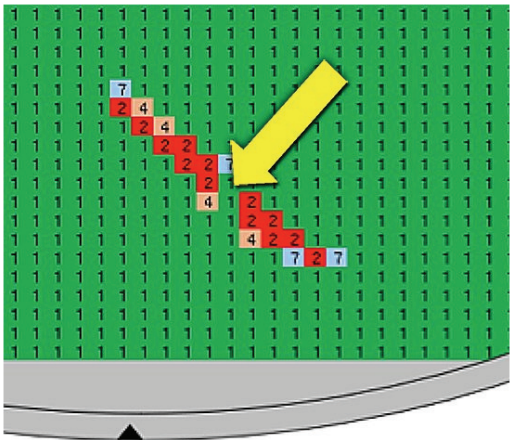


Image 1. Guardbanding can remove these questionable mid-scratch die

Putting guardbanding to work earlier

To date, guardbanding has been used primarily at end-of-line testing — but it can also play a critical role during in-line inspection. That's because final inspections can still miss a variety of defects that occur earlier in line. For example, certain in-line problems can get covered over by subsequent processing steps and become very difficult to detect later. For this reason, in-line macro defect inspection and in-line guardbanding have become essential complements to traditional micro inspections and electrical testing.

In-line macro defect inspection and guardbanding — at high speed

With today's generation of ultra-high speed automated macro inspection tools, such as the EagleView from Microtronic, fabs can now inspect every wafer in the lot — without need for sampling or recipes. This allows fabs to inspect many more wafers at many more processing steps — to correct process and equipment issues sooner, and to save more wafers from being scrapped or affected in an excursion. And in addition to identifying in-line macro defects, EagleView also makes it easier to guardband those defects…

Some fabs still use a hand-drawn paper tracing system to enable guardbanding, which is time consuming and inaccurate. With the EagleView platform, guardbanding is performed directly on a high-resolution wafer image, for maximum precision and ease.

The tool may be set to automatically add guardbanding to some defects, or an operator may add guardbanding selectively to specific defects. Some types of scratches, for example, may scatter particles onto surrounding die. Image 2a shows a scratch detected by macro inspection. Image 2b shows the same wafer at wafer probe, and Image2c shows the scratch with guardbanding added.

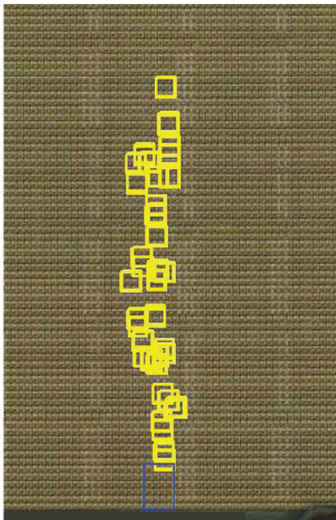


Image 2a. Scratch defect detected by macro inspection

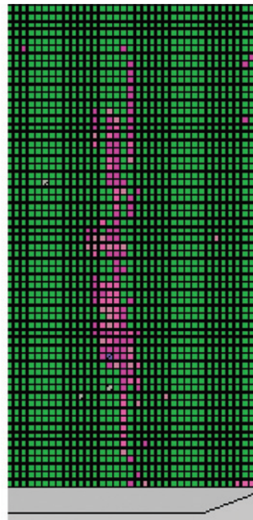


Image 2b. Same defect at wafer probe

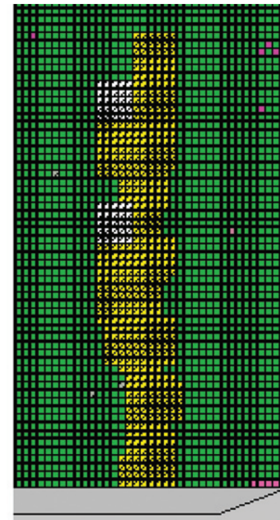


Image 2c. Wafer probe with guardbanding

Integrating defect data from more sources

The macro inspection tool produces a true high-resolution, permanent-record image of every wafer, which builds a powerful, comprehensive database of defect information for the fab. These files provide a rich and valuable data resource for end-of-line testing, for root cause analysis of current in-line problems or to refer to at any time in the future.

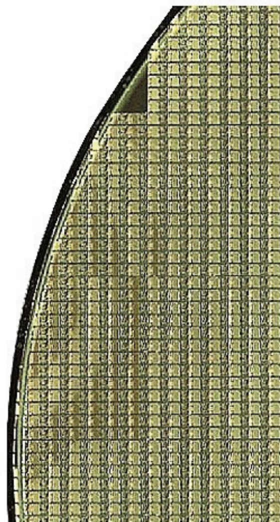


Image 3a. A photo hotspot detected by macro inspection

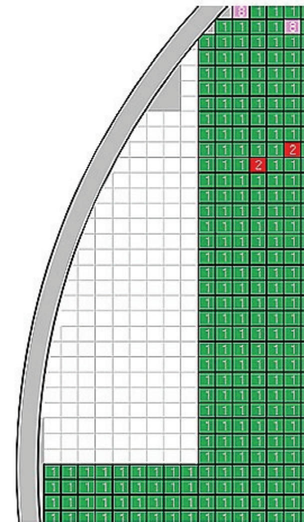


Image 3b. At wafer probe with stepper shot guardbanded

Importantly, the EagleView system can also import KLARF files from micro-inspection tools (Image 4a) and overlay them onto the EagleView image (Image 4b) where a user-defined buffer can be applied real-time. The wafer probe map is displayed in Image 4c, and Image 4d shows the resulting guardbanded wafer probe map. EagleView can use SEMI standard G85 wafer maps or apply a translator for legacy probe map systems.

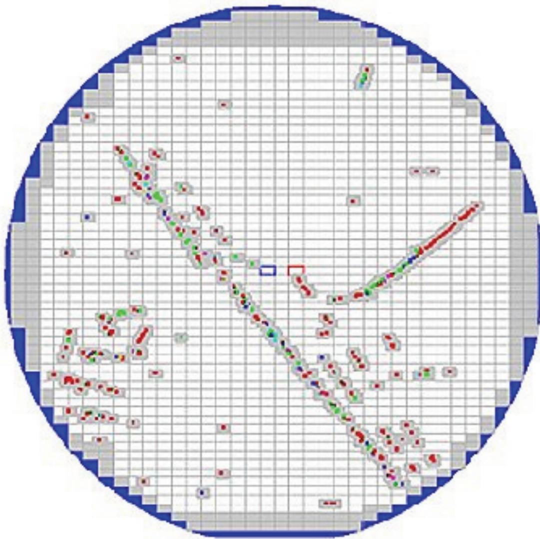


Image 4a. KLARF file from micro inspection

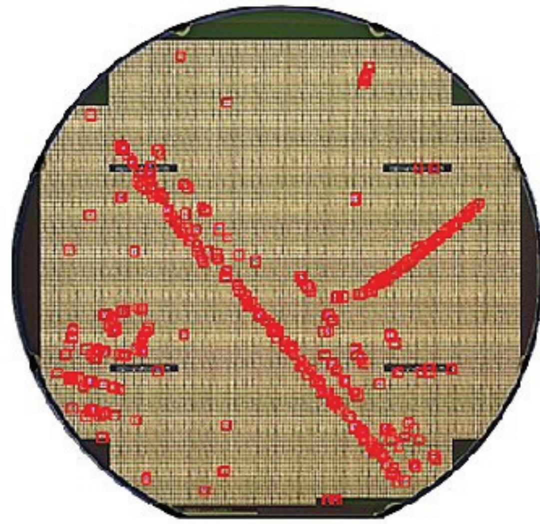


Image 4b. KLARF file overlaying EagleView wafer image

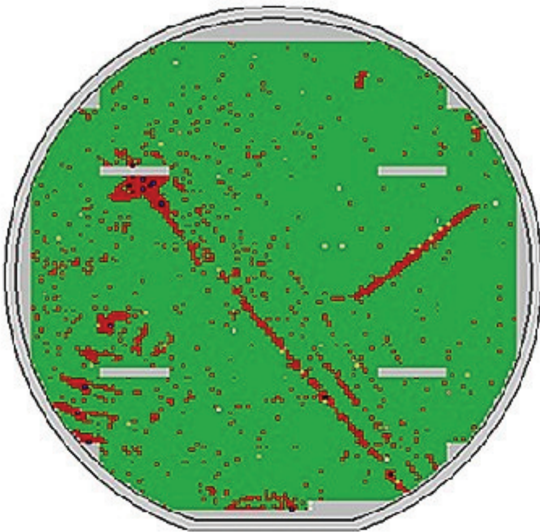


Image 4c. Probe map of the same wafer

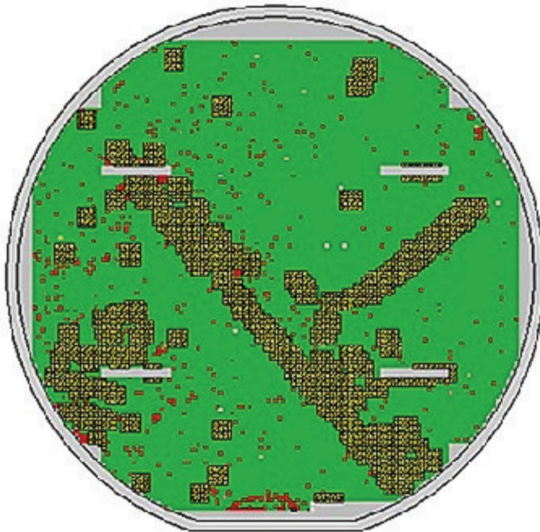


Image 4d. Wafer probe map with guardbanding

Doing more to enhance chip quality

Today, there are still many ways for defects to slip through final testing and get shipped to customers. However, in-line macro defect inspection and guardbanding are important and powerful tools that can help fabs to catch more problems earlier — to improve chip reliability, reduce returns, and keep customers happier.

Specializing in semiconductor macro defect inspection

For more than two decades Microtronic has been working to optimize semiconductor wafer macro defect inspection to enhance yields and reliability. If you have questions in any of these areas, please just call us at (508) 627-8951 or email info@microtronic.com.

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