

Breaking News!

A Story of Successful GaAs Backend Process Improvement

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Keywords: ... Grinding, Thinning, Breakage Reduction

Abstract

A successful GaAs wafer breakage reduction strategy is described. A systematic approach was used to understand the many factors that cause wafer breakage. Problem solving methods, including Six-sigma methodologies led to understanding of the grind process, and some surprise causes of wafer breakage. A data-driven decision making process is used to determine the major causes of wafer breakage in the grind process, and to reduce wafer breakage by 95% over the period of investigation.

This paper examines detailed wafer breakage reduction activities by the Skyworks Wafer Fab Backend Core Team. In September and October of 2009, we experienced a spike in wafer breakage at the GaAs grind process. The weekly breakage rate exceeded 10% for some weeks. This breakage resulted in scrap, since there was no mechanism to continue the broken wafers through the remaining process steps.

A cross-functional team was formed, with operations, EHS, facilities, process, equipment, and quality engineering.

The team looked at process commonality, and saw that there was a commonality of higher breakage on some substrate lots from a particular vendor. Further analysis of the suspected boules with an infrared grey-field polariscope showed an anomaly “the line”. While this was an interesting finding, the team realized that implementing a screening process would not be a manufacturable solution, and moved on to the realization that we had more work to do to develop a grind process to overcome any substrate related stresses.

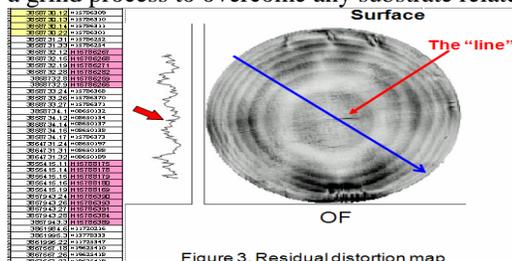
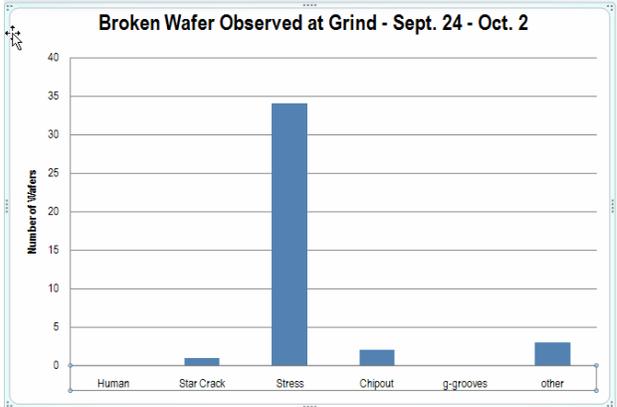


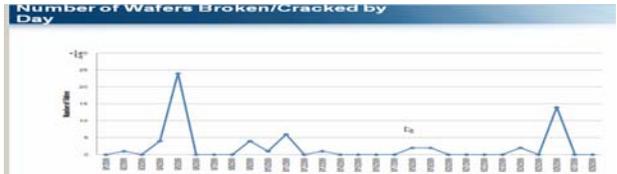
Figure 3. Residual distortion map

We looked at the data currently collected on breakage, and realized that it was not precise enough to help us solve the problem. A new data-collect system was designed and put in place 9/09 to automatically populate a database with breakage events at grind. The new data collect allowed us to have good visibility of the type of breakage, and at what point in the backend process flow it occurred. Below is a chart showing the different categories of breakage. By focusing on the causes of each type, we were able to implement solutions to reduce or eliminate the breakage. Detailed descriptions of the investigation, result, and improvement strategies for each breakage type will be given during the presentation.



- Data Collect added to all Grind recipes to track types of breaks
- Data collect released & active from September 24

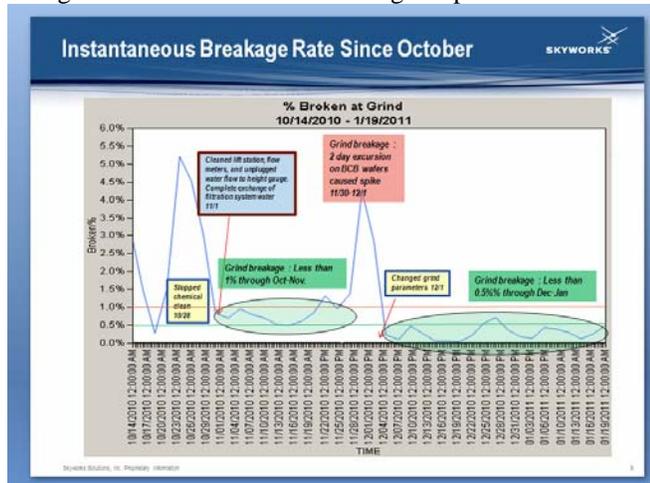
The chart below shows “star crack” breakage rate. Star cracks were traced to a particle contamination on a robot arm. When a particle attached to the arm, it would cause a crack on every subsequent wafer in the run. Initially we focused on detection and containment, and then worked with the vendor on prevention. Star cracks are no longer an issue.



The team was relentless in looking at all causes of breakage. In this quest to eliminate breakage, we looked at

- Robot arm upgrade: its effect on star crack yield loss.
- Investigate table angles on grinder to reduce down force of the grind wheel.
- Investigate grinder removal amount and rate. Evaluate slower removal at the coarse grind step, and more removal and/or slower removal at the fine grind step.
- Validate all grind changes with wafer strength measurements, and grind breakage trend analysis.
- Investigate alternate hard substrate mount options.
- Investigate impact of recirculating/filtered grind water chemistry on grind process.

The chart below shows a timeline of yield vs. process changes that were introduced to the grind process.



The CS Mantech presentation will examine detailed wafer breakage reduction activities employed by the Skyworks Wafer Fab Backend Core Team. Similar activities might be employed at another GaAs wafer fab to reduce wafer breakage and increase the line yield. Case studies of our most interesting and successful findings will be presented.

As a result of our never-ending quest for perfect quality, Skyworks has been able to effect a 90% reduction in GaAs wafer breakage and to increase the line yield by 3 % over the last 2 years. The chart below tells a compelling story of the success of the team's efforts.

