Savigent SOFTWARE

CASE STUDY

Inline Metrology System

Industry

Semiconductor Manufacturing

Application

Savigent Platform™

Background

This semiconductor manufacturer was scrapping too many wafers late in their recording head production process. Savigent Platform was used to enable an inline metrology step with the primary purpose of identifying indicators of scrap at a step where rework was still an option, therefore reducing scrap costs dramatically.

Results

Scrap was reduced by over 50 percent within six months after the Savigent Platform-based inline metrology system was installed. This reduced scrap equated to over $3.7 million annually (or more than $10,000 per day).

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CASE STUDY

Introduction

This semiconductor manufacturer makes recording heads for reading and writing data to disk drives. In many ways, the production steps used to make recording heads are similar to those used to make semiconductor integrated circuits. Recording heads are fabricated using a wafer as the base material and adding up to 50 layers of conductors and insulators to form the recording head. The wafer is eventually diced into tens of thousands of recording heads, making a single wafer worth tens of thousands of dollars depending on where it is in the manufacturing process.

After wafer-level processing, in contrast to integrated circuit fabrication where chips are obtained by a dicing process, recording-head fabrication relies on many additional complicated and expensive processes, such as precise lapping, subsequent thin-film deposition, photolithography and dry etching, to produce completed recording heads. As a result, a wafer of integrated circuits with 40 percent final yield after wafer processing may be of great value, while a recording-head wafer of such a yield may not be worth processing further because of the continued yield loss and cost associated with subsequent operations. This makes early detection of any production problems that may reduce yield of one or more recording head wafers critical.

Problem Statement

Late-stage production testing found "zero-yield" areas on wafers which resulted in either scrapping areas of the wafer or the entire wafer depending on the severity of these "hot spots." Further Investigation of the upstream production steps showed that the source of the trends was caused by either a wafer problem or a process problem. Though these two problems looked the same during the detection phase, it was critical to distinguish between the two because a process problem resulted in "hot spots" showing up on repeated wafers in the same location, therefore multiplying the scrap impact.

It was determined that a metrology step was needed following the photolithography step in order to determine whether the wafer was within specifications for further processing steps. Photolithography is a process used to selectively remove parts of a thin film. It uses light to transfer a geometric pattern from a photo-mask to a light-sensitive chemical on the substrate. A series of chemical treatments then engraves the exposure pattern into the material underneath the photo-resist. Since photolithography is a re-workable process (as opposed to subsequent process steps) and also was an excellent indicator of whether a wafer was within specifications, this step was the ideal place for inline metrology.

Solution

Using Savigent Platform, an inline metrology system was developed to analyze the metrology data and look for one of two error conditions. While the exact nature of the error conditions and the processes that produced the error conditions are considered proprietary to the manufacturer, a generic description of the error conditions is given below.

Error Condition #1

This error condition indicated a wafer problem. Identification of a "hot spot" would trigger a rework process to first determine whether this particular wafer could be reworked in a way that would reduce the potential for scrap. This early identification alone would save wafers from proceeding to subsequent irreversible process steps and prevented a costly condition where some or all of the wafer may need to be scrapped.

Error Condition #2

This error condition was identified after five "hot spots" were detected in the same area of consecutive wafers. This condition indicated a process error and caused an immediate tool look out event in order to prevent further faulty processing. This caused the upstream processes and tools to be checked out by a qualified engineer to prevent further potential for scrap.

Result

There were several secondary benefits of the system, such as better visibility and control of upstream production processes, but the primary result of installing the Savigent Platform-based inline metrology solution was a dramatically reduced scrap rate. The failure rate fell from 13 failures per day to six per day over the first six months after the initial system was installed. This represents an overall reduction in scrap of over 50 percent just by monitoring this single step in the production process. Conservative estimates from the customer of the savings in reduced scrap add up to over $3.7 million annually (over $10,000 per day). These savings do not include secondary benefits of reduced scrap such as saving the engineering time and machine time involved in lengthy rework and inspection processes.