Overall Equipment Efficiency Improvement for GaAs Fab Evaporators

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Abstract

This paper reviews how six sigma methodology principles and total preventive maintenance (TPM) drains analysis have been utilized to increase overall equipment effectiveness (OEE) on the metal deposition operation in our GaAs wafer fab.

INTRODUCTION

To maintain a competitive advantage in the semiconductor industry, it is very important to follow a model of continuous improvement. At Skyworks, this model includes practices to ensure our fab equipment is operated with high efficiency. To meet the factory throughput demand, the thin films team was recently given the challenge of increasing evaporator capacity by 10 percent in a three month period. To meet this goal, the team considered all inefficiencies in the process. Using the standard industrial engineering description, OEE is defined by: tool availability x final product yield x tool speed rate. In addition, the evaporation process is controlled by many variables and is performed in a complex tool, both of which provide constraints to the OEE. The use of continuous improvement methodologies such as six sigma and TPM provided the team with the structure needed to meet the initial capacity goal, and go beyond this goal to relieve pressure from a bottleneck toolset. These methods and specific examples will be discussed in this paper.

PROCESS OVERVIEW

The first step of the project was to collect historical tool availability drains and review/validate data with a cross functional team including manufacturing, process engineering, equipment engineering and industrial engineering. Areas of opportunity with the shortest implementation time were selected in order to meet the phase I project timeline. During the second phase of the project, the areas of opportunity with the biggest positive impact on performance were selected since the time constraints were more flexible. Weekly meetings continue to be held to discuss project status, review next areas of opportunity, and prioritize actions to ensure resources are focused on the most important areas. .

AREAS OF IMPROVEMENT ANALYSIS

Improvement of capacity and efficiency has been gained (1) by redefining how we do things (changes in processes) and (2) by reducing traditional manufacturing process losses (closing the gap between ideal and actual tool/operation performance). The list below shows the areas of opportunity identified and what was done to improve performance as summarized in Figure 1. These areas will be discussed further in the final paper and presentation.

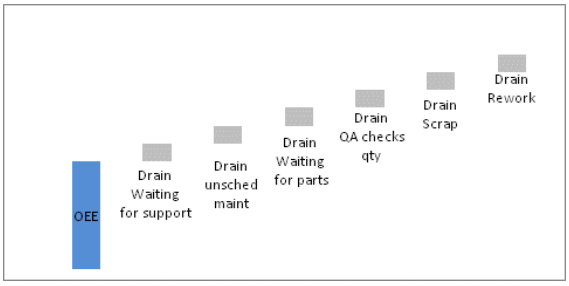

Figure 1..Example of Evaporator Manufacturing Losses

Process Changes

- Tool recipe optimization: Recipes optimized reducing processing time.
- Tool pump down time reduction: Hardware upgrade allows a faster pump down time,

reducing overall tool processing time. 5 percent OEE gained on first step of the project.

Tool Availability Efficiency Losses

- Evaporator waiting for assistance
  - Manufacturing techs headcount increased.
  - Real time status monitor installed on the production floor. Change of status on any tool can be easily seen by the support group. Also, timers indicate a particular status duration to allow manufacturing techs to plan ahead. (See Figure 2 below)

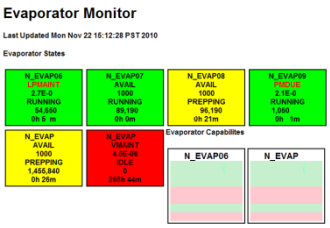

Figure 2. Screen shot of evaportator real time status monitor.

- Evaporator waiting for parts
  - PM kits inventory control. PM kits service loop optimized, kits inventory increased while tracking service loop cycle time.
  - Manufacturing technicians' tool spares (tweezers, magnet holders, etc.) made available in stock room for easier replacement in a central location.
- Evaporator unscheduled maintenance
  - Tool setup procedures optimization. Protection of the high voltage area when preparing tool reduced amount of short circuit errors.
  - Preventive maintenance intervals reduced to reduce metal peeling events. Preventive maint time + unscheduled maintenance time overall time reduced.

Product Yield Losses

- Scrap rework raw material related
  - Raw material quality improved with vendor.
  - Raw material supplier redundancy underway.
- Scrap/rework human intervention related
  - Monthly all hands communication meetings.

OPERATION PERFORMANCE FEEDBACK

To heighten awareness of the evaporator performance, the daily operation performance is shared with the team and management, as shown in Figure 3.

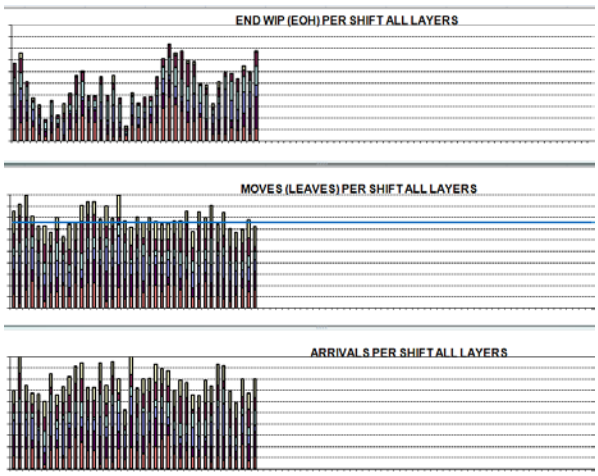

Figure 3. Daily operation performance charts

This allows the team to be aware of and quickly address any decrease in productivity. The team recently added a weekly yield review, as well. Monthly all hands communications meetings are used to share performance information and get additional feedback from the manufacturing floor.

FUTURE PROJECTS

1. Operation performance collection system.

As the team improves overall performance, identification and control of the next area of opportunity becomes more difficult. Development of a more precise data collection system will allow the team to identify areas of opportunity and monitor/control gains obtained.

2. Minimize amount of time chamber is open.

This reduction has a positive impact in pump down time. Wafer loading/unloading automation could help keep pump down times low. Application of single minute exchange of die (SMED) will also help us minimize the amount of time the chamber is open.

3. Tool speed tracking (tack time).

OEE = up time x yield x tool speed. Currently, we have the capability to measure most of the variables that define OEE. However, we still need to build the ability to track tack time into our system.

CONCLUSIONS

Following a systematic approach towards manufacturing efficiency improvement has helped the thin films team better utilize equipment and human resources. The team not only closed the required 10 percent capacity gap in a three month period, but also has increased capacity above the goal. The team put controls in place to make sure these gains are kept through time and continues working together to improve the metal deposition operation efficiency.