Incorporation of SPC Charts into MESA for the Subμ-CMOS process

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Abstract – In a manufacturing process environment, it is important to have precise control over all of the steps involved in making the final product. The device yield goes down when the tools go out of specification. This is where the use statistical process control (SPC) charts, aids in the improvement of the entire manufacturing process. SPC charts help by letting the engineer for the tools understand whether the process is resulting in mean of the data that is higher away from the target or vice-versa (is the data reaching the upper control limit or lower control limit). The project explains the procedures and results of adding statistical process control charts for the Subμ-CMOS process to the WIP (work in progress) tracking software used at Rochester Institute of Technology's Microelectronic Engineering fabrication facility. Also out of control criteria will need to be setup to know if the process is out of control or not. Out of Control action plans will also be setup. The WIP software package, Manufacturing Execution System Application (MESA), is installed on an IBM iSeries eServer operating OS/400. This interfaces out to a x86 Wintel PC running Quality Analyst, a statistical software package. Setting up queries in MESA does interfacing between the two programs i.e. MESA and Quality Analyst. The queries that are setup help in generating files on the AS/400 server that can be read by Quality Analyst on the local PC. The control chart for the last few runs on the machine is displayed on the user's screen, providing instant information about reliability and control. Tool preventive maintenance and improvement experiments will be more efficient, and manufactured results will have higher yields.

1. INTRODUCTION

R.I.T has a processing lab known as Semiconductor Manufacturing facility Lab. This lab is capable of running both 4" and 6" wafers. It runs various processes like the PW-3 process, PW-4 process, MEMS process, Subμ-CMOS processes, etc. The information resulting from each of the steps is stored on a centralized computer database. RIT uses a software known as MESA (Manufacturing Execution System Application) which is an integrated relational database system for discrete part manufacturing (a computerized record-keeping database). This software helps in tracking the status of the lots. The basic operations of MESA include adding new tables to the database, inserting new data into existing tables, retrieving data from existing tables, updating data in existing tables, deleting data from existing tables, removing existing tables from the database and quarrying database tables for specific information.

This system has provided the means of collecting and storing the information since it was first installed. However, gathering the data required making queries, so that control charts could be plotted using Quality Analyst. In addition, preventive maintenance schedules could be altered to improve the amount of money RIT would have to spend on key components.

2. PROCEDURE

There were three main steps to complete this project

A. MESA Setup

It was decided that the simplest approach to solving the problem of requiring instructions along with a graphical output of a chart was to let MESA interface directly to Microsoft PowerPoint first. This was accomplished right in the instructions for processing the lot. A user would enter a "1" in the column on the process instruction screen to display the associated document. (See figure 1) This document was previously created in PowerPoint and was a standalone show (*.pps) that would automatically run.

Figure 1 – Command to display SPC chart

The other, more important, setup required for MESA was setup queries. A lot of information is stored with the lot data that is collected, such as time of day, operator name, etc. The desired information for displaying on the control charts needed to be sorted out and selected for automatic extraction. In addition, individual names to these queries were needed for later access not only in the MESA screen but also through the open database connectivity (ODBC) driver that Quality Analyst used [2].

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Text
1.0 Use Lower 6" LPCVD Tube (Primary), Recipe NITRIDE 810
2.0 If Lower 6" LPCVD Tube is occupied,
    Use 4" LPCVD (secondary)
3.0 Include D1-D3
4.0 Include bare dummy wafer to measure nitride thickness
5.0 Thickness desired = 3000 A (see subnit02.pps)
6.0*See SPC chart for operation (nitride.pps) - execute step
7.0 LPCVD Nitride at 800 C for 34 min (use SPC chart)
8.0 Measure nitride thickness on dummy wafer
9.0 Record 3-zone temp, dep pressure, time, thickness
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B. Quality Analyst Setup

The next step was to setup Quality Analyst. When a control chart is created in Quality Analyst, it creates a header file (*.hed) and a run file (*.run). The header file defines the variables to display, the data range, control limits, and axes titles from the database query. The run file defines which query to run, where to temporarily store the data, and which charts to display.

Most of the time and effort put into setting up Quality Analyst comes in forming the header file. Most of this was easily accomplished through a graphical user interface. The terms chosen for control chart investigation were the lot dates and the mean of the run (film thickness, critical dimension width, etc.). Once the terms were chosen for the charts, the run file needed to be created to read in the data. Using the "connect" command, this causes Quality Analyst to issue a command to MESA, making a brand new chart of the most up to date information. Lastly, the two charts that were initially integrated were the x-bar and process capability charts

C. PowerPoint Setup

The last step was to setup the PowerPoint slides. These were all based on a similar format, allowing the operators to become familiar with the universal layout quickly and easily. The first page gives a basic summary of the information about to be presented. (See figure 2) It displays links for the user to either display the current control charts, both an x-bar and a process capability chart, or an action plan to take when the control chart displayed is out-of-control. The action plan is simply another PowerPoint slide, whereas the link to the control charts is a Quality Analyst run file that causes Quality Analyst to start.

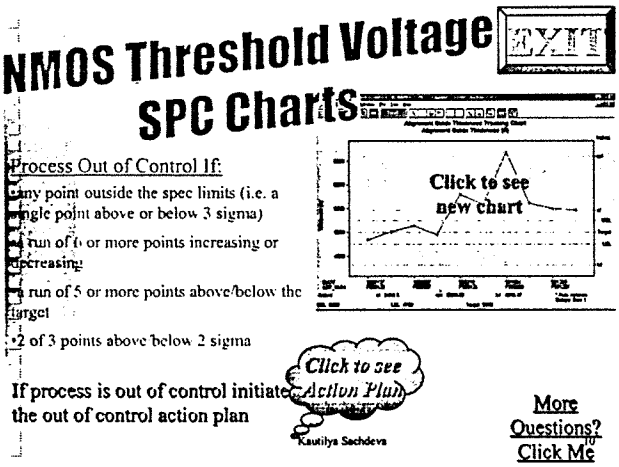

Figure 2 – PowerPoint instructions and chart link

3. RESULTS

Microsoft PowerPoint and Quality Analyst were successfully integrated with MESA. The Subμ-CMOS processes were setup for control charts. As most of the process recipes were the same (for 4inch wafers and 6inch wafers, MESA was setup to generate the same queries for both revisions. The only query that was different was for the photolithography steps. This was because the 4" process prints 4μm CD's while the 6" processes prints 2μm CD's.

Results for a typical control chart display are shown in figure 3. It was chosen to display both the x-bar and process capability charts at the same time on the user's display, for correlation purposes.

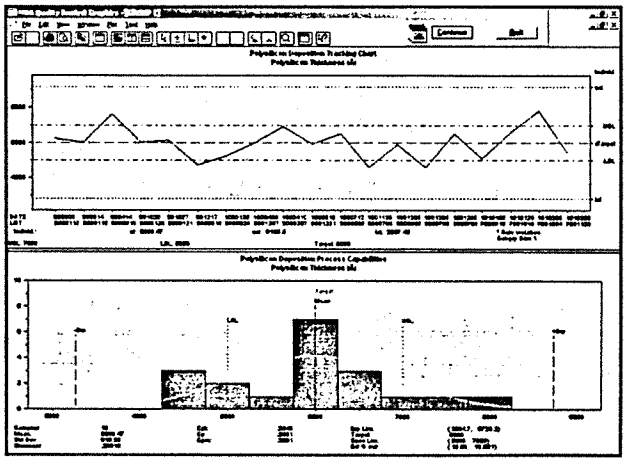

Figure 3 – Quality Analyst SPC charts

Automatic access of the database without an upper level access password is automatically configured when the user logs on to the MESA system. This allows for universal access to the data on the local intranet. In addition,

when properly configured, any user could also connect to the system via the Internet.

Equipment results for process capability and preventive maintenance schedules have yet to be determined. The information gathering phase was set to begin upon the completion of this project.

4. CONCLUSION

Integration of the graphical means of analyzing the data collected by MESA was a key improvement to the wafer fabrication facility at RIT. A complete instruction set for creating the required control charts from step one was also created for further statistical integration into RIT's Subμ CMOS processes. Further investigation into some of the preliminary process limits will come as the control charts help to improve the equipment in use.

REFERENCES

[1] "NWA Quality Analyst User's Manual," Northwest Analytical Incorporated, 1999.
[2] "Statistical Process Control Reference Manual (Release 2.0), Camstar Systems Incorporated, 1999.

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