ID FW-O-010.doc

EES Analysis of Candidate Apparatus with Trouble Extracted by MapSSA – H. Matsushita

A.Iyama, H.Miyashige, Y.Arakawa, K.Kadota, T.Ikeda, M.Hatano and H.Kakinuma
hiroshi.matsushita@toshiba.co.jp
Toshiba Corporation, Semiconductor Company
8, Shinsugita-Cho, Isogo-Ku, Yokohama, 235-8522, Japan (Yokohama Facility)
Phone: +81-45-776-5360 Fax: +81-45-776-4115

ABSTRACT

We performed automatic classification of wafer test maps and specified the root cause apparatus with yield loss trouble. We often extract several candidate apparatus with yield trouble from statistical test of yield data. We extract several candidate apparatus with yield trouble from the viewpoint of yield management and specify the true cause apparatus by EES. We monitored the EES parameters to detect the yield loss trouble.

INTRODUCTION

For the purpose of yield improvement, it is useful to analyze wafer maps obtained by electrical test. We proposed the MapSSA (Spatial Signature Analysis) system that classifies wafer maps automatically [1][2]. We select lots that have a common failure pattern and specify the apparatus with yield trouble by the machine difference analysis.

We often extract several candidate apparatus by MapSSA or machine difference analysis, which are statistical methods. We think it is important to analyze EES (Equipment Engineering System) data for specifying the true cause of yield trouble. We describe the technique for yield improvement by the linkage of YM (Yield Management) and EES.

MapSSA and EES Data System

MapSSA is an automatic classification system for wafer maps. It calculates the density of failure chips in multiple regions in a wafer and transforms wafer maps to waveform. Wafer maps are classified into peripheral, center, all aspects and so on. Yield impact is calculated with a combination of electrical test and failure pattern category. We can monitor the failure trend of the entire factory.

We collect the EES data of the equipment and operate the data-base system for EES and MapSSA. We analyze the EES data of apparatus with yield trouble extracted by MapSSA and specify the root cause of the trouble.

RESULT and DISCUSSION

We noticed the occurrence of electrical test A – center – shot failure shown in Fig.1 detected by MapSSA. We extracted three lithography apparatus supposed to be the cause of this failure (Fig.2, candidates 1 – 3). The shot failure occurred significantly in these lots processed with these apparatus.

Multiple processes or apparatus are extracted as the root cause of the failure from the viewpoint of yield management in two cases. One is a case where the lot distribution among the apparatus is narrow because the distance between the processes is short. The other is a case where classification error exists in MapSSA. We set loose threshold values for the machine difference analysis with MapSSA in consideration of these uncertain factors. Therefore, multiple candidates for the failure were extracted in many cases.

We analyzed three candidate apparatus for the shot failure by PLS-DA (Partial Least Square – Discriminant Analysis). Fig.3 shows the result. In candidate 1, primary and secondary principal components clearly separated according to normal and abnormal lots. On the other hand, in candidates 2 and 3, there is no significant difference between normal and abnormal lots. One notices that there is a right and left separation in candidate 2. However, this change in the apparatus is irrelevant to the failure. From these results, we concluded that candidate 1 is the true root cause of the shot failure. Then, we set the SPC (Statistical Process Control) rules for these parameters to detect the shot failure (Fig.4).

SUMMARY

The machine difference analysis with MapSSA is a technique to extract the candidate apparatus for the yield failure from the viewpoint of YM. We collected apparatus information including the error. We can find out the true root cause for the failure by EES. This method is very effective for yield improvement.

REFERENCES

[1]H.Matsushita et al.: AEC/APC Symposium, FW-O-16 (2007)
[2] H.Matsushita et al.: ISSM , YE-O-043, (2008)

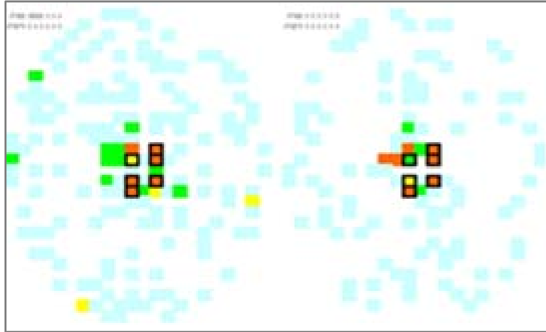

Fig.1 Wafer maps of electrical test A – center – shot failure
We detected the occurrence of this failure by the MapSSA system.

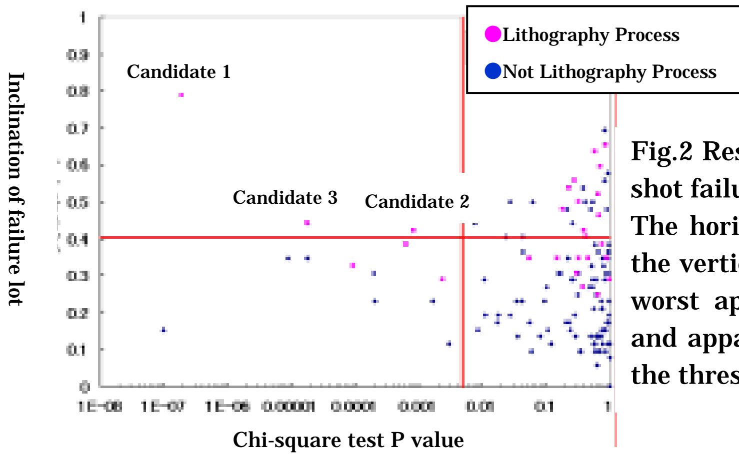

Fig.2 Result of the machine difference analysis of the shot failure
The horizontal axis is the chi-square test value and the vertical axis is the inclination of failure lot in the worst apparatus. The point represents one process and apparatus. We extracted three candidates above the threshold.

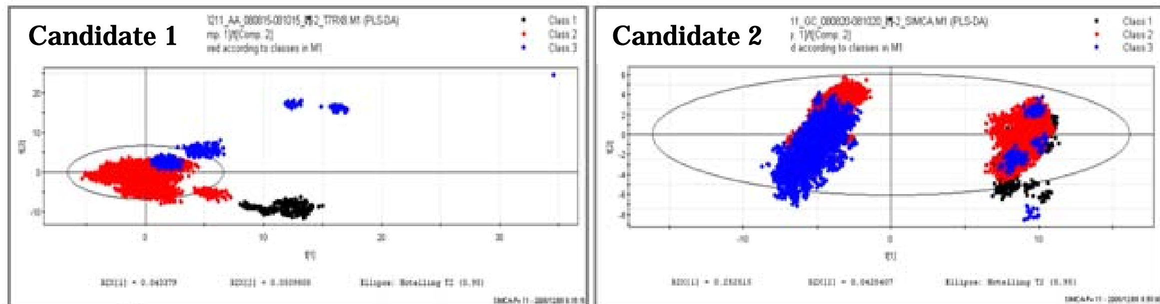

Fig.3 Result of analysis of EES data by PLS-DA
The horizontal and vertical axes are primary and secondary principal components, respectively. The black, red and blue plots represent normal, abnormal and after measures, respectively. In the case of candidate 1, we extracted the change of the apparatus related to the failure. However, in the case of candidate 2, the left and right separation is irrelevant to the failure.

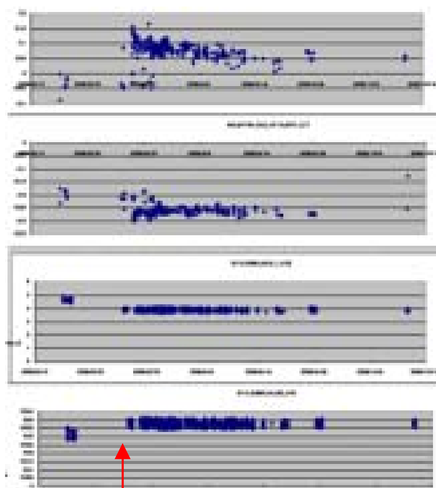

Fig.4 Result of the trend of the parameters related to the failure
We specified four parameters for the cause of the shot failure. We monitored these parameters to detect the shot failure.