Implementation of VM-APC Automated Execution System for Cu-CMP Process

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Introduction

A wide variety of prediction/control method is required to deploy Virtual metrology (VM) and advanced process control (APC) by complex design and miscellaneous LSI products. It is big challenges to operate a lot of prediction models with taking account of their variety and complex [1][2][3]. This report describes construction and deployed examples of Process Control System (PCS). This report describes the case of applying VM-APC to Cu-CMP.

VM-APC Model

Figure 1 shows the VM-APC configuration. Calculate rate prediction value by VM using PLS using processing data of CMP apparatus.

A normal VM predicts measured values, but this time predicts a common polishing rate among products and processes using active current value etc. as the explanatory variable. The explanatory variable was not limited to the latest processing. The model can cope with missing data, delays, etc. within a range that can ensure accuracy without any problem in APC.

We cannot predict rates in the past extension after equipment maintenance. We built a model that uses the data from equipment QC to predict the polishing rate of the product immediately after equipment maintenance.

APC uses the VM predicted polishing rate to calculate polishing time and instruct the equipment.

The polishing time prior to APC is indicated, for lots which polishing time cannot be calculated.

System Implementation

Figure 2 shows the system configuration. A PCS acquires necessary information from Manufacturing Execution System (MES) and Factory Equipment Engineering System (F-EES), calculates VM-APC on the PCS, and instructs a processing time to a processing machine. Acquisition of such information is a general method such as access to a database held by each system.

If the calculation results may be wrong or not calculated due to various factors, it is necessary to pass reasonable instructions to the equipment without disturbing the lot flow. It is difficult to obtain the effect of APC application complicated process or products. This time, in addition to the standardization of polishing rate prediction models, a mechanism to absorb QC differences between processes and products is implemented.

It is necessary to switch the model during equipment maintenance and model, system abnormality, and so on. We incorporated all the processes to collect the necessary information and judge.

We used Enterprise Application Integration (EAI) tools to reduce coding complexity reduce the complexity of combining these judgments and data.

Results and Discussion

We built a system that implemented the requirements up to the previous chapter, and applied APC to some products. The system works without problems and VM-APC is applied to the lot. Figure 3 shows the post-CMP film thickness with and without VM-APC. Since the targets differ depending on the product and process, the differences with respect to targets set after CMP are displayed here.

The lot with VM-APC applied has an average value close to 0, and the variance is less than half.

Conclusion

We built a film thickness control mechanism using VM - APC and started automatic operation. With the film thickness close to the target, the variation was reduced to half before the application of VM-APC.

References

[1] S. Yasuda, T. Okazaki and K. Nomura: “The VM・APC activities in Sony Semiconductor”, PC-O-22, AEC/APC Symposium Asia 2013

[2] K. Nomura, T. Okazaki, S. Yasuda, A. Kawashima, H. Tani and K. Matsuda: “Virtual Metrology of Dry Etching Process Characteristics using EES and OES”, PC-O-018,AEC/APC Symposium Asia 2011

[3] T. Uemura, T. Yoshimoto, T. Okazaki, K. Nomura, M. Ikeda, S. Yasuda and Y. Tanaka: “Prediction and Stabilization of MOSFET Threshold Voltage by VMAPC using Factory Data”, MC-O-30, AEC/APC Symposium Asia 2015

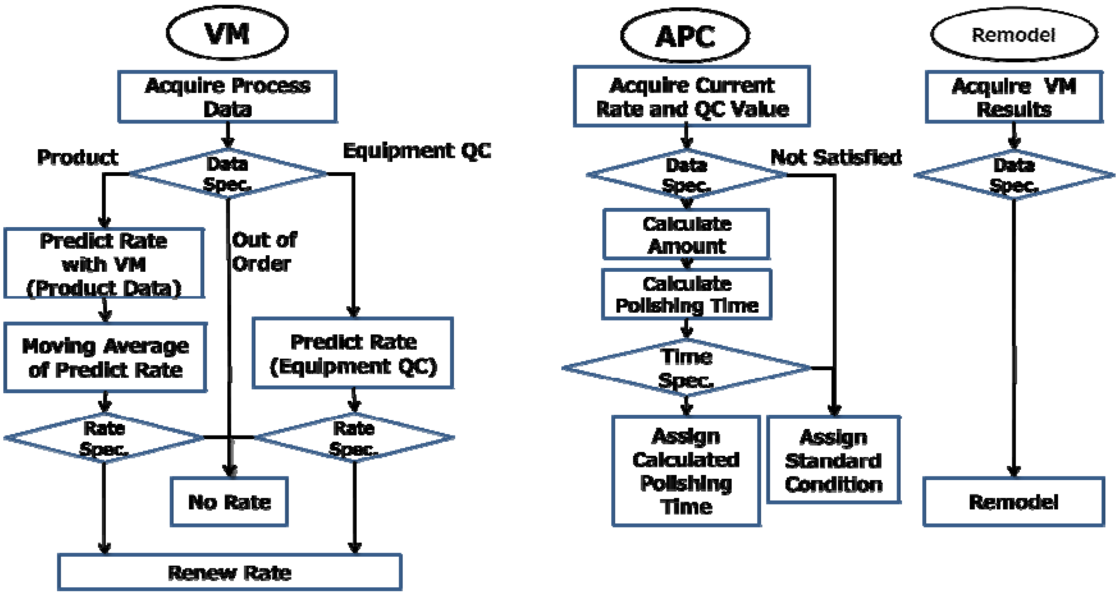

Figure 1 VM-APC Flow

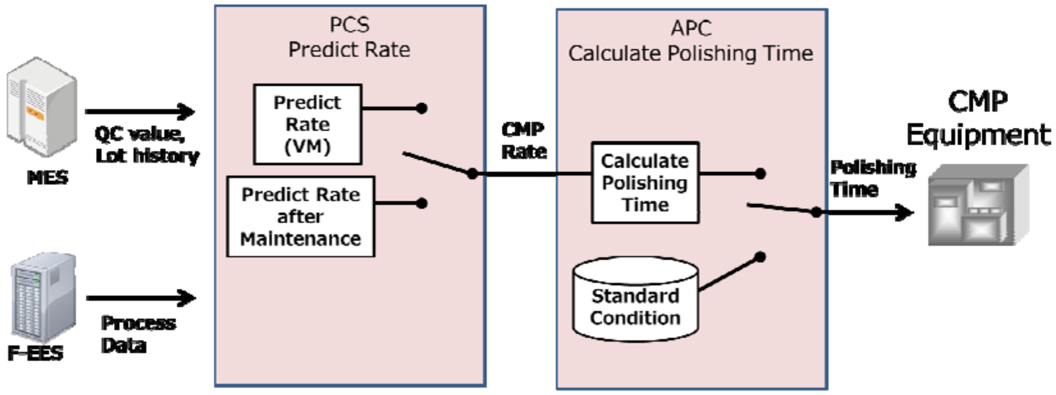

Figure 2 VM-APC System Configuration

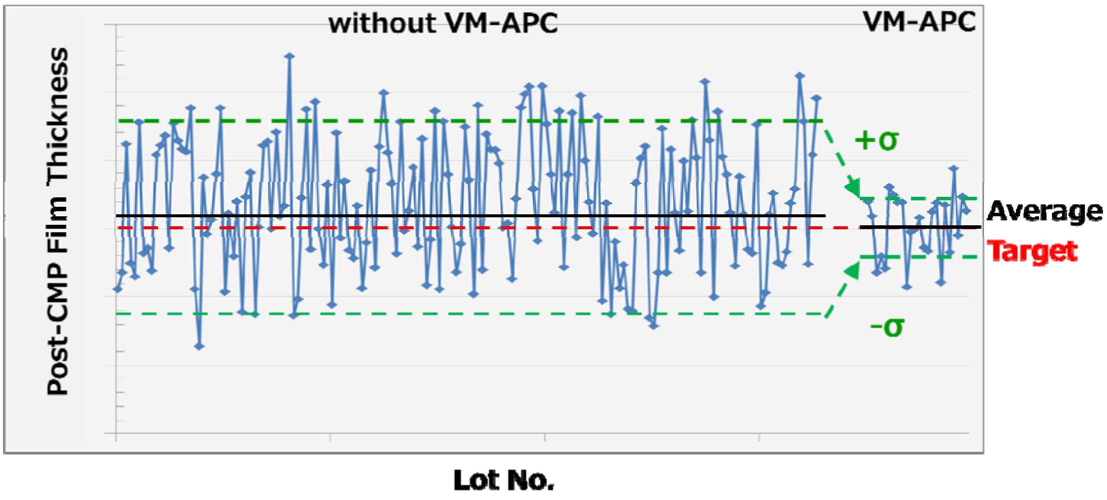

Figure 3 Film Thickness after CMP