Novel Batch ALD Reactor Design for Advanced Microelectronics and Nanotechnology Manufacturing

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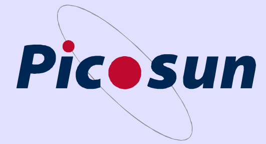


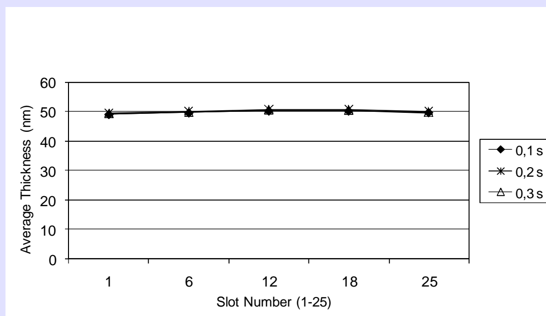
Novel production-worthy ALD batch tool was developed and used in High-Volume Manufacturing (HVM).

INTRODUCTION

Cost-effective utilization of expensive factory floor area has been addressed by the development of compact ALD batch tool for high throughput processing of substrates. SUNALE™ Picobatch ALD tool was used for handling 25 pcs. of 4″ Si wafers in a batch. Al_2O_3 thin films were grown at 300 °C from $(CH_3)_3Al$ (TMA) and water.

RESULTS AND DISCUSSION

The growth of alumina thin film was not sensitive to changes in deposition parameters, such as TMA pulse time or N_2 carrier gas flow rate.

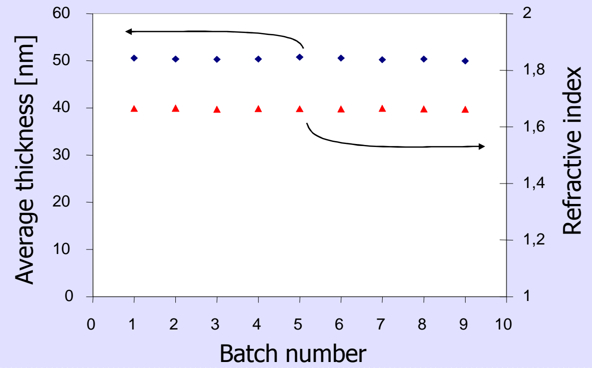


The growth rate of Al_2O_3 was insensitive to the length of TMA pulse (0.1 – 0.3 s). There are negligible differences in the growth rate between wafer slots.

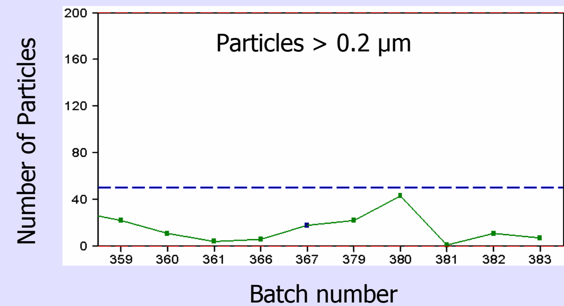
Measured process data was clearly within the production specifications.

	Process specification	Measured process data
Within wafer	< 1 %	0.6 %
Within batch	< 2 %	1.0 %
Batch to batch	< 2 %	0.3 %

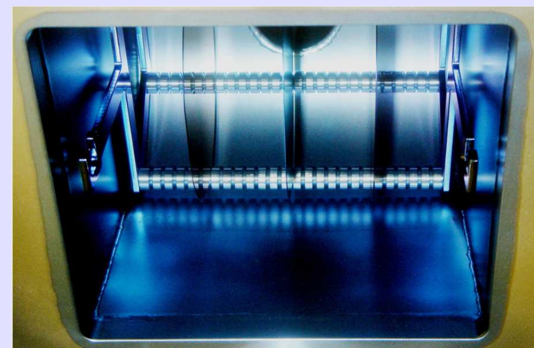
The delivered ALD batch system fulfilled customer's specificiations for their six-sigma quality production line. Film uniformity: 1σ, STD, 9 points on each 100-mm wafer. Each batch consisted of 25 wafers.



Repeatability between batches was 0.3% (1-sigma) in the Al_2O_3 process. Each data point is an average of 5 measured points on a wafer in the same slot number.



Total number of > 0.2 µm particles for the 50-nm Al_2O_3 thin film process at customer's site. Number of particles stays below 50 in hundreds of batches.



Uniform blue interference color is seen on all heated surfaces within the ALD reaction chamber after growing 100 nm of Al_2O_3 thin film.

CONCLUSION

SUNALE™ Picobatch ALD tool with < 1 m^2 footprint was introduced. Batch to batch repeatability of 0.3 % (1δ) and within wafer uniformity of 0.6 % (1δ) were obtained in production environment. Deposition of a 50-nm thin film and handling of wafers added only down to four > 0.2 µm particles on a 4″ wafer. Novel ALD batch tool design enabled cost-effective HVM of advanced microelectronics and nanotechnology devices.