Photolithography control in wafer fabrication based on process capability indices with multiple characteristics

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Abstract

Shrinking device geometries and demand for high wafer throughput place a great demand on semiconductor process development, while this development is highly dependent on the advancement of photolithographic technologies. Typically taking about one-third of the total wafer manufacturing costs, photolithography is one of the most complex operations and is the most critical process in semiconductor manufacturing. While many parameters need to be controlled, three most important parameters that determine the final performance of devices are critical dimension (CD), alignment accuracy and photoresist (PR) thickness. Process yield, a common criterion used in the manufacturing industry for measuring process performance, can be applied to examine the photolithography process. In this paper, we solve the photolithography production control problem based on the yield index Spk. The critical values required for the hypothesis testing, using the standard simulation technique, for various commonly used performance requirements, are obtained. Extensive simulation results are provided and analyzed. The results indicate that a sample size greater than 210 is sufficient to ensure that the decisions made are insensitive to the process precision and the process accuracy. The investigation is useful to the practitioners for making reliable decisions in either testing process performance or examining quality of an engineering lot in photolithography.

Keyword：Photolithography, critical dimension, alignment accuracy, photoresist thickness, process yield, critical value.