Reduction of Wafer Misalignment by Pressure Distribution Control with Experimental Validation

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1. Abstract

Photolithography is a standard semiconductor manufacturing process to transfer the circuit design to a wafer, requiring over 35% of semiconductor manufacturing cost. Baking is a common step that heats up the wafer using a lift pin up/down module, as shown in Fig 1, consisting of a pneumatic cylinder and three supporting pins. As the module ages over repeated up and down cycles, the vertical movement of a wafer may not be consistently controlled, often resulting in wafer misalignment, as shown in Fig2. The heat profile across a misaligned wafer during the baking step may not be consistent, which adversely affects the quality of each chip within the wafer.

This paper presents an approach to reduce wafer misalignment with a modeling study and experimental validation. The degree of misalignment was approximated by the air volume under the wafer and was controlled by the height difference between the pins. Modeling and experimental results demonstrated that the degree of misalignment was improved by controlling the pin's height difference. The correlation between the degree of pin's height difference and the degree of misalignment was obtained.

2. Experiment

To measure the wafer misalignment, the maximum acceleration of wafer was observed. The acceleration was assumed to be dependent on the probability of wafer misalignment occurrence.

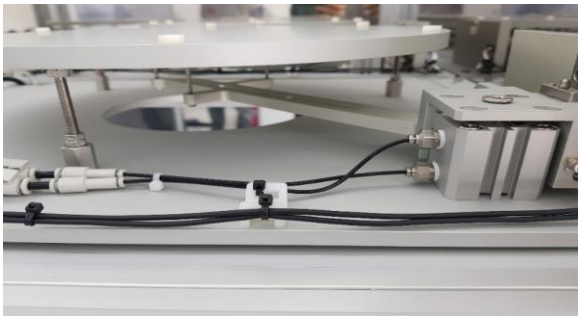

Fig.1 Bake lift up/down module

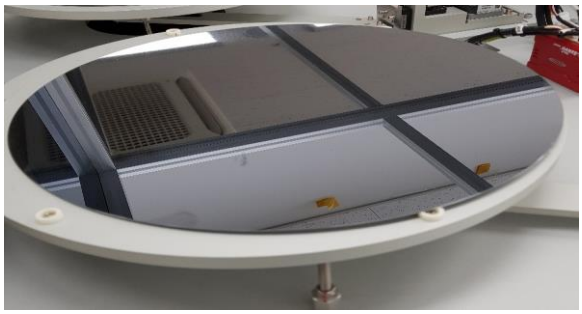

Fig.2 Wafer misalignment

The experimental settings are as follows.

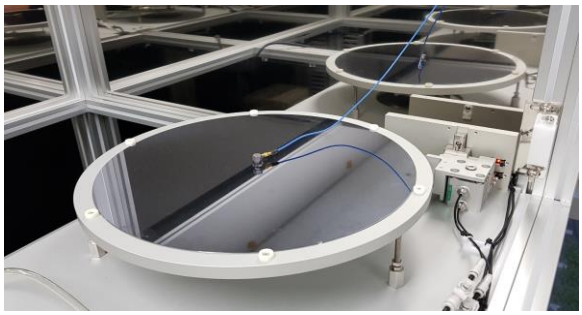

Fig.3 Experimental settings

Table 1 Experimental settings

Accelerometer	352C65
Sensitivity	101.4 mV/g
Sampling Rate	10 k/s
Lift up speed	11.33 mm/s
Wafer Size	300 mm
Wafer Thickness	0.75 mm
Wafer Weight	127 g
Accelerometer Weight	2 g
Temperature	25 ℃

To measure the maximum acceleration changes under the volume change, the experimenter controls the height difference between the pins. Among the three pins, the height of the marked pin (Fig.4) was adjusted to 2mm by 0.5mm, and the

maximum acceleration was measured under the changed volume.

Fig.4 Three pins

The changes in maximum acceleration due to the changed volume is as follows