

Investigation of particles in the dicing saw usage environment

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Abstract

Particle measurement was performed in the area surrounding the dicing saw installed inside the class 10000 clean room on the normal floor. Eight points in the front, back, left, and right of the machine were measured three times at heights of 30 to 100 cm. The particle measurement results for both dicing saws met the criteria. No significant increases in particles were observed in areas where increases in particles were expected to occur. It may be able to operate as a class 10000 clean room even on the normal floor if managed appropriately.

1. Introduction

In the past, the level of cleanliness required of clean rooms used in the semiconductor assembly process was not high in comparison to the level of cleanliness required in front-end processes. However, with advances in devices and thinner wafers in recent years, there are cases of using clean room environments and structures that meet front-end process standards for the thinning and singulation processes that are directly after the front-end process, and even some cases of grated flooring⁽¹⁾ being adopted to increase the laminar flow and reduce the number of particles.



Fig. 1. Grated flooring

However, in Japan, a country subject to earthquakes, there have been cases in the past where grated flooring has become dislodged and the equipment has fallen over during an earthquake because the optimal grated flooring was not selected and the optimal methods to secure the equipment were not performed, resulting in injury, a large amount of downtime, and costly expenses for repairs and restoration.

Because the standard level of cleanliness in the assembly process is Class 10,000 (Class 7 in ISO standards, see Fig. 2), even normal flooring is thought to be able to sufficiently achieve a level of environment that does not affect the process.

In this study, we measured the number of particles that are generated in a Class 10,000 clean room in which dicing saws (hereinafter “dicers”) operate and which adopts normal flooring.

Class of cleanliness		Upper concentration limit (particles/m ³)					
ISO14644-1	Fed.Std.209D (Applicable particle size 0.5um)	Measured particle size					
		0.1µm	0.2µm	0.3µm	0.5µm	1.0µm	5.0µm
Class1		10	2	–	–	–	–
Class2		100	24	10	4	–	–
Class3	Class1	1,000	237	102	35	8	–
Class4	Class10	10,000	2,370	1,020	352	83	–
Class5	Class100	100,000	23,700	10,200	3,520	832	29
Class6	Class1,000	1,000,000	237,000	102,000	35,200	8,320	293
Class7	Class10,000	–	–	–	352,000	83,200	2,930
Class8	Class100,000	–	–	–	3,520,000	832,000	29,300
Class9		–	–	–	35,200,000	8,320,000	293,000

Fig. 2. Clean room category

2. Method of Experiment

The particles in the dicer operating environment were measured using the method described below.

2-1. Measuring Environment

The measurements were performed in a Class 10,000 clean room environment used in a package assembly factory in Japan. The flooring consisted of both grated flooring and normal flooring, and there was a down-flow of clean air through ceiling filters. The normal flooring in the clean room is cleaned once a day with an adhesive roller and a dry mop.

2-2. Equipment

More than ten 300 mm fully-automatic dicers are installed on the normal flooring. Two of the dicers were selected for this experiment. The positions of the measured dicers are shown in Fig. 3.

2-3. Measuring Method

Measurements were performed for a duration of one minute using an airborne particle counter. Each point was measured three times at intervals of one minute.

A total of eight points were measured: points approx. 10 cm from the front, back, left, and right of the dicers at heights of 30 cm and 100 cm. Refer to Fig. 4 for details. At each measurement point, a particle size of 0.5 µm or higher was measured at a conversion volume of 28.3 L, in accordance with ISO 14644-1⁽³⁾. The measurements were performed while the dicers were being used in fully-automatic operation.

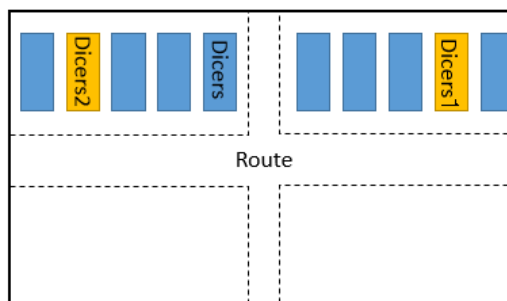


Fig. 3. Placement of measuring equipment

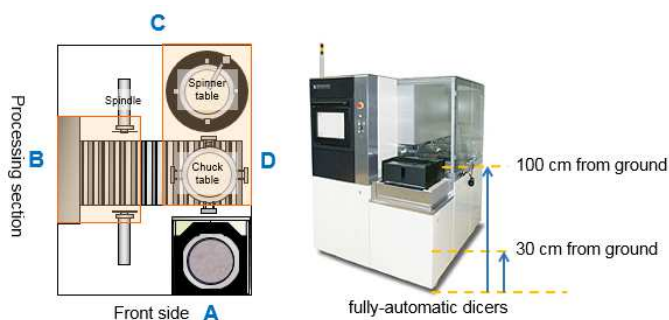


Fig. 4. Places measured on equipment

3. Measurement Results

The total number of particles in each set of three measurements are shown in Fig. 5. A quantity of 30,000 particles or lower can be said to meet the criteria of Class 10,000. For both dicer 1 and dicer 2, the accumulative quantity of particles for three measurements was less than 30,000 in all of the locations. A large amount of particles were observed at point A (front of equipment) at a height of 100 cm for both dicers. In particular, point B (processing section where dicing is performed) had a particularly high amount of particles for both dicers.

4. Discussion

The level of cleanliness with the dicers in operation was within the criteria of a Class 10,000 clean room.

Based on the results of this experiment, we have confirmed that if appropriate cleaning is being performed, there is no extreme increase in the amount of particles in a Class 10,000 level environment, even if the dicers are installed on normal flooring. Regarding point B (processing section), where it was easy for particles to be generated, because there were no large quantities of particles indicated for either dicer 1 or dicer 2, we have clarified that it would be effective to install a duct which forces the particles from the processing section toward the exhaust port.

The reason we think that the quantity of particles measured at point A was high is because point A is next to the aisle where many people pass through, and also because it is on the front side of the equipment, which is where the user operates the equipment. We also think that

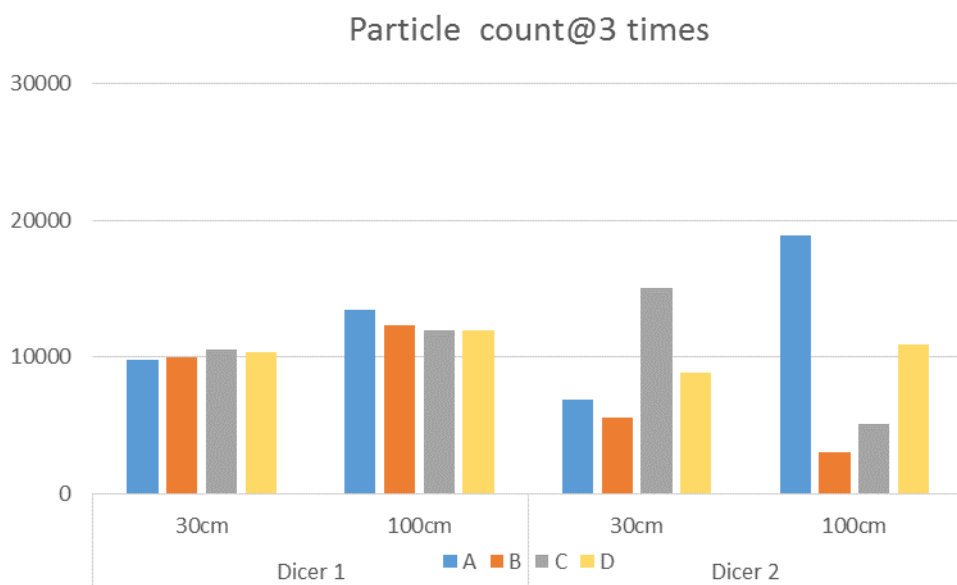


Fig. 5. Total of three measurements around dicers on normal flooring

verifying the dependability according to changes over time and the type of equipment shall further clarify whether it is possible to use normal flooring.

References

- (1) “SEMI and SEAJ Collection of Examples of Individual Accidents: Guidance in Practical Application”, August 21, 2018
<http://www.seaj.or.jp/publication/safety/tebiki.pdf>
- (2) Shiro Hara 2006, “The World of Local Clean Environments”, Industrial Research Committee
- (3) ISO 14644-1:2015

Appendix

The area around the UV irradiation equipment and inspection equipment installed on the grated flooring in the same clean room was measured as a reference. Please refer to Fig. 6.

There are other various factors in addition to the flooring composition that are suspected to have generated the particles.

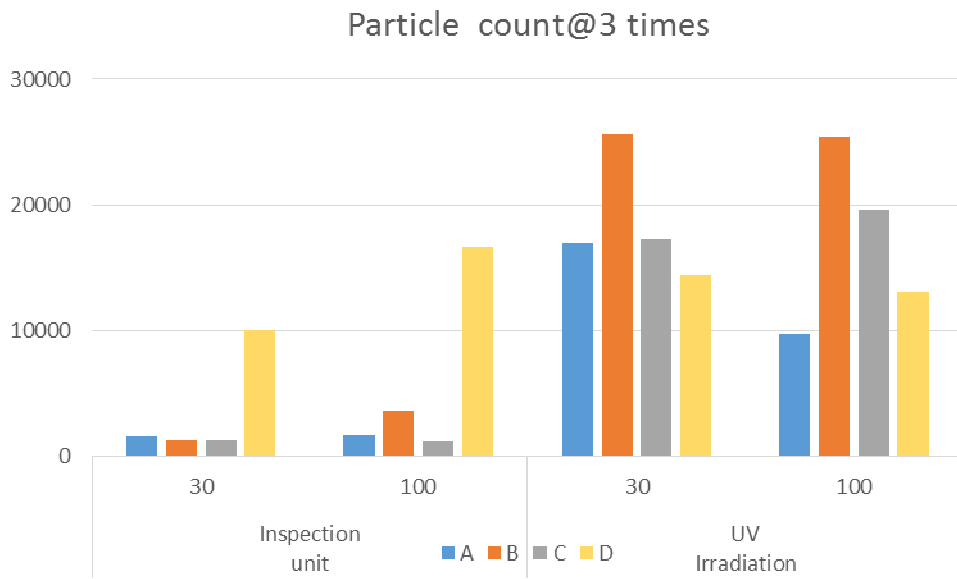


Fig. 6. Total of three measurements around equipment on grated