Pressure-Sensitive Adhesive Tape for Water Jet-Guided Laser Dicing Process

1. INTRODUCTION

As semiconductor devices improve in packing density in these years, the size increase and thickness decrease of wafers is proceeding worldwide, requiring also improvements of tapes for semiconductor use in terms of function and performance. Thus in the wafer dicing process where a blade-cut method is generally applied using a dicer or a slicer, it is anticipated that "chipping" of wafers becomes more likely to occur when silicon wafer substrates of small thickness undergo dicing.

Laser μJet Dicing is drawing attention as a new dicing method that can suppress chipping. Figure 1 shows the principle of Laser μJet Dicing in which a water jet several tens of μm in diameter is used to guide a laser beam to dice the wafer. This technology, owned by Synova of Switzerland, is expected to significantly reduce chipping compared to the conventional blade-cut dicing.

In terms of adhesive tapes for wafer dicing, whereas ultraviolet curing (UV) tapes of UC series could be used in blade-cut dicing, these have to be improved in performance so as to be applicable to Laser μJet Dicing. This report describes the features of Laser μJet Dicing together with the detailed performance of pressure-sensitive adhesive tape developed at this time for this technology.

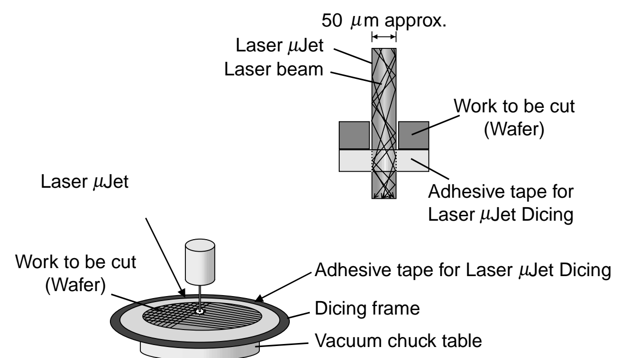

Figure 1 Principle of Laser μJet Dicing.

2. FEATURES OF LASER μJET DICING

Laser μJet Dicing can cut wafers in a non-contact manner. Because of this, the method is expected to offer the following advantages when applied to the dicing of thin wafers.

1) It can drastically reduce the mechanical stress on the work, suppressing occurrence of chipping or micro cracking.
2) Cutting speed can be significantly increased.
3) It prevents breakage of wafers likely to be induced by blade-cutting, thus eliminating problems of quality degradation. Moreover, the exchange, adjustment etc. of blades becomes unnecessary.
4) Scribe lines can be made narrower.
5) Because water jet is used as a guide, it cools off the heat in wafers generated during dicing, reducing thermal loads. In addition it suppresses occurrence of contamination, thus facilitating subsequent cleansing work.
6) Because the laser light source can be moved in the x- and y-directions, cutting along a curved line is feasible.

3. PERFORMANCE OF ADHESIVE TAPE FOR LASER μJET DICING

In Laser μJet Dicing the water jet several tens of μm in diameter used for guiding the laser beam impinges upon the work. Therefore, an adhesive tape for dicing is required to allow the water jet to pass through from the scribe line to the rear surface of the tape, i.e., the substrate film of the tape has to be provided with micro through-pores. The developed adhesive tape is made of such materials as with the following characteristics.

1) Not to be damaged when irradiated by a laser beam.
2) The tape has to be pervious to water.
3) To eliminate chipping during dicing.
4) Not to give forth fibrous elements during cutting.
5) To suppress transfer of adhesives on to the rear surface of the chip at pick-up.
6) The tape has to be uniformly expandable.

The adhesive tape for Laser μJet Dicing is designed using an adhesive that is based on a UV-curable adhesive, realizing a strong adhesion holding the work during dicing together with easy peeling when irradiated with UV after dicing. Table 1 shows the adhesive strength of the

Table 1 Adhesive strength of adhesive tape for Laser μJet Dicing.

Product FS-1006			FS-1006	FS-1063	FS-1076
Adhesive force (N/25 mm)	on SUS	Before UV	2.20	1.85	2.80
		After UV	0.41	0.50	0.39
	on Si	Before UV	1.07	1.03	1.63
		After UV	0.21	0.19	0.12

Note 1: The figures represent typical values, not guaranteed values.
Note 2: Measuring conditions for adhesive force are as follows.
Test surface: SUS304 surface polished with #280 or Si wafer with mirror surface
Peeling angle: 90°
Peeling speed: 50 mm/min
UV irradiation: 1000 mJ/cm^2

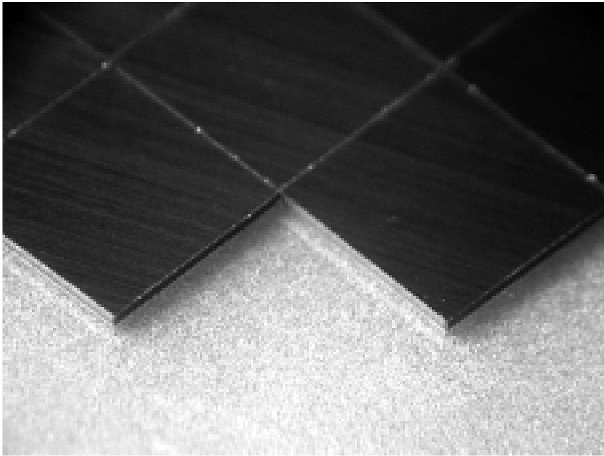

Photo 1 Appearance of back-chipping.

tape, demonstrating a significant decrease in adhesion force after UV irradiation. Photo 1 shows that the chipping on the rear surface of a wafer has disappeared by Laser μJet Dicing using the developed tape, resulting in a smoothly cut surface.

4. IN CONCLUSION

We intend to develop hereafter innovative adhesive tapes best suited for Laser μJet Dicing, focusing on upgrading of functions such as expandability. For detailed information, please refer to the following.

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