High Productivity Technology for Semiconductor Process

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1 Abstract

WLP applications such as FO-WLP and FI-WLP are expanding recently from the viewpoint of miniaturization and electrical characteristics of semiconductor PKGs.[1)] This assembly is conventionally conducted by one-by-one die replacement process after dicing for die gap widening by using die-mounter. As miniaturizing and thinning of the die, the issues of time-consuming step to replace die one-by-one and the die crack have been revealed.[2)] To solve the issues, we developed a high productivity process that does not require die replacement and a new expanded film essential to the process.[3)] This process consists of the expanding step of the film on which diced-wafer is mounted and the transferring step of the all dies to the carrier simultaneously. Therefore, the new process doesn't need the time-consuming die replacement. In this report, we discuss the development of the expanding film and a series of the processes.

2 Characteristics of the Product

- Highly adhesive film that has high expandability for significantly expanding the die gap without causing die peeling.
- Process that enables high productivity by eliminating the need for die re-placement.

3 Background of the Development

Because die have become smaller and thinner, die cracks occur during the WLP assembly process. The side protection process, which covers the periphery of the die with encapsulating material, is the most common solution to this problem. The general flow of processes for this solution is as follows: (1) dice the wafer; (2) re-place the die on the carrier by using a die mounter that widens the die gap; (3) perform overmolding; (4) dice the molding material after peeling the carrier. However, as die become smaller, the number of die increases as a result, and the process of re-placing die on the carrier requires a significantly greater amount of time. Therefore, we have developed a high-productivity process that does not require die re-placement (**Figure 1**), as well as a new expanding film.

4 Technical Details

The properties of the expanding film we developed are shown in **Table 1**. Measurements of the die gaps after expansion were obtained by measuring the points shown in **Figure 2**. The expanding film has higher peeling strength and higher expandability in comparison with the properties of conventional films. The initial die gap (after dicing) of approximately 0.05 mm can be widened to 1.5 mm after the film is expanded. In addition, the results of visual observation and die gap measurement after expanding and molding revealed that no die peeling or die shift occurred during the series of processes (**Figure 3**). Furthermore, it was verified that no die peeling or cracking of the molding material occurred even in the dicing process after molding. Thus, the series of processes using the expanding film was verified.

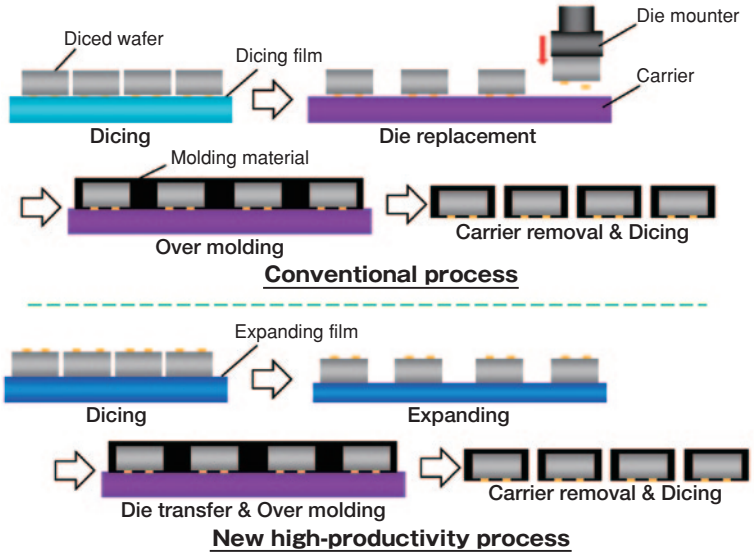


Figure 1 Conventional process and high productivity process flow with expanding film

Table 1 Properties of expanding film

Item		Unit	Conventional dicing film	Expanding film
Film thickness		μm	110	110
Peel strength*1	Before UV irradiation	N	1.0	6.0
	After UV irradiation	N	0.2	0.2
Die gap after expanding*2*3		mm	< 0.1	Up to 1.5

*1) Peel strength width: 25 mm
*2) Evaluated size: 8 inch wafer, die size 5 mm × 5 mm
*3) Expanding condition: Temp 50℃
Thrust-up speed 5 mm/s
Thrust-up height 100 mm

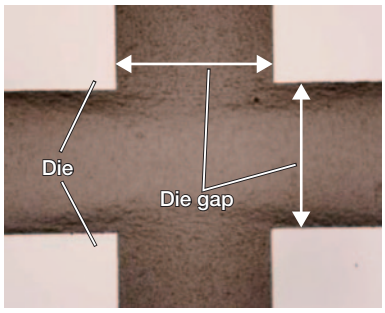
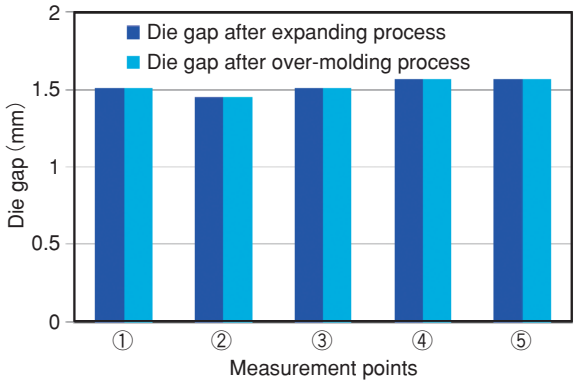


Figure 2 Measurement points of die gap



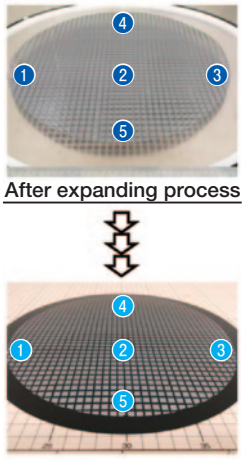


Figure 3 Die gap after each process

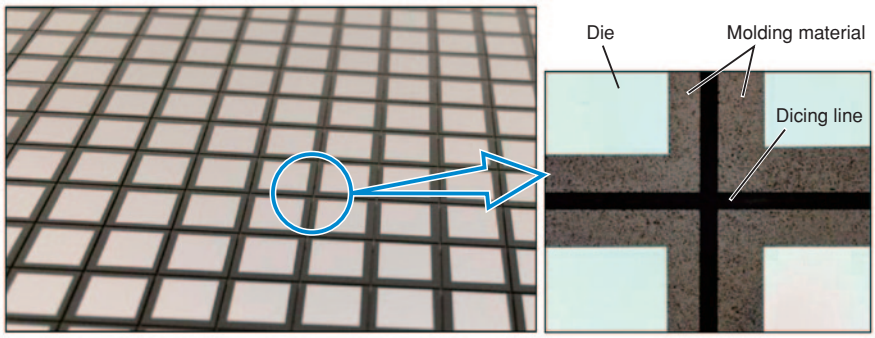


Figure 4 Molding material dicing

5 Future Business Development

・Deployment of this technique to FO-WLP and to micro LEDs (light emitting diodes)

【References】

1) Chien-Fu Tseng, Chung-Shi Liu et al., "InFO Wafer Level Integrated Fan-Out Technology", Proceedings of 2016 Electronic Components & Technology Conference.
2) Tom Tang, Albert Lan et al., "Challenges of Ultra-thin 5 Sides Molded WLCSP", Proceedings of 2016 Electronic Components & Technology Conference.
3) Kazutaka Honda, Naoya Suzuki et al., "Expanding film and process for high efficiency 5 sides protection and FO-WLP fabrication", Proceedings of 2017 Electronic Components & Technology Conference.