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Process Enhancement to Eliminate Adhesive Film Remains during Die Picking

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read, reviewed and approved the final manuscript.

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ABSTRACT

Adhesive film remains on the dicing tape is one of the problems encountered in diebonding or die attach process during the pick-up process of silicon dies. With this occurrence, one method used to identify the root cause is the process mapping from wafer preparation to diebonding. Adhesive film remains are found occurring during the process, affecting the manufacturability and assembly yield of the semiconductor package. By resorting to a new and improved die attach adhesive film material, occurrence of its remains was mitigated during the diebonding process.

Keywords: Adhesive film; die attach; wafer preparation; assembly; semiconductor.

1. INTRODUCTION

The process of picking and bonding an individually sawn silicon die from a wafer tape to a carrier is known as diebonding or die attach process. This process is a highly recognized in all semiconductor industry, especially in attaching small die sizes with thin die thickness to meet the customer requirement. One of the adhesives used in semiconductor industry is the die attach film (DAF) [1-3]. It is a type of adhesive mounted underneath the silicon die and used to connect the silicon die to a carrier. Currently, new technologies are getting enlarged and improved in semiconductor industry and one of which is the development of new die attach

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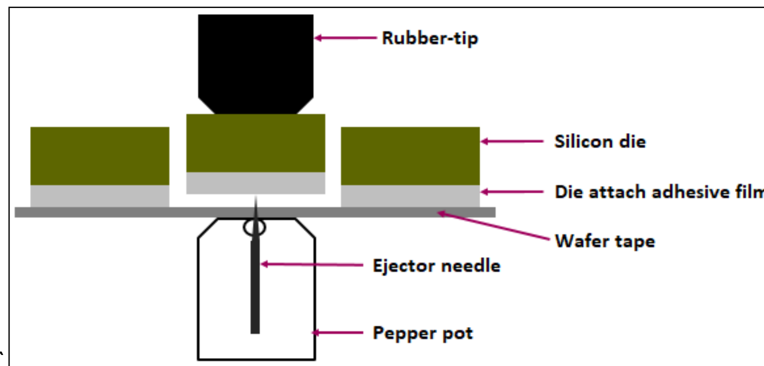

Fig. 1. Die attach pick-up process [4]

adhesive film materials. However, this technology contributes numerous problems during the development stage of the semiconductor package. During die attach process pick-up process of the silicon die, the requirement is that there must be no adhesive film remains in the wafer tape to get a good adhesion during die bonding into the semiconductor carrier.

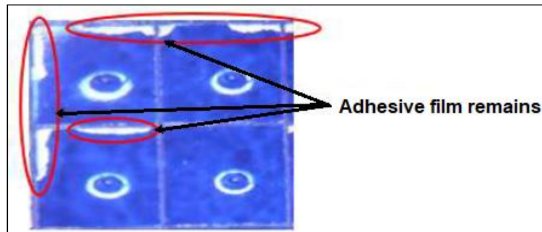

Fig. 2. Adhesive film remains on the wafer tape [4]

In this paper, an evaluation is designed for dual flat no-leads (DFN) semiconductor device comprising of a tapeless leadframe carrier and a die attach adhesive film that will undergo qualification to ensure the package robustness and to clearly analyze the significant effect of the new adhesive film in resolving the defect occurrence. Fig. 1 shows the actual die attach pick-up process.

As earlier mentioned, one of the issues encountered during die attach pick-up process specific in semiconductor package is the adhesive film remains on the wafer tape. Die attach adhesive film remains is a type of defect in semiconductor industry wherein some of the adhesive film in the wafer tape are not totally picked up. When the die ejector needle pushes up the silicon die which is then picked up by the rubber-tip, there are adhesive film remains observed on the wafer tape. A sample of the defect is shown in Fig. 2, which is mainly caused by the sticky wafer tape on the film. During package development stage, process mapping is employed to identify the problem. With this challenge, one of the solutions is to come up with an alternative solution of the material in order to have a good reliability response and to completely eliminate the occurrence of adhesive film remains.

2. METHODOLOGY

In this study, one of the methods used to identify the problem is by process mapping, wherein all processes that possibly contribute in adhesive film remains are analyzed. It is worthy to note that assembly process flow varies with the product and the technology [5-8]. Fig. 3 shows the processes used in the process mapping. First is wafer preparation followed by wafer grinding and die attach adhesive film lamination. Lamination is the process of attaching the film underneath the silicon die and into wafer tape. Wafer sawing process is where the silicon dies are cut into individual units, readying for die attach. As highlighted in the figure, adhesive film remains were seen during the die attach pick-up process.

3. RESULTS AND DISCUSSION

The improved die adhesive film material was evaluated and eventually resolved the occurrence of assembly rejects particularly the top contributor which is the adhesive film remains on the wafer tape. Note that criteria for assembly rejects and visual inspection are governed by internal specifications and work instruction documents [9-10]. Fig. 4 shows the actual wafer tape picked with no adhesive film remains.

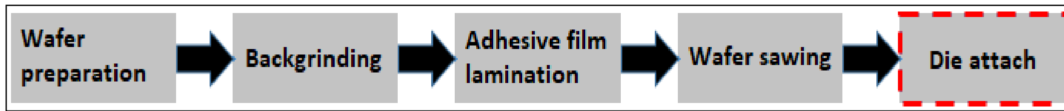

Fig. 3. Process mapping flow at front-of-line stations

Fig. 4. Improved die attach adhesive film material showing no adhesive film remains on wafer tape

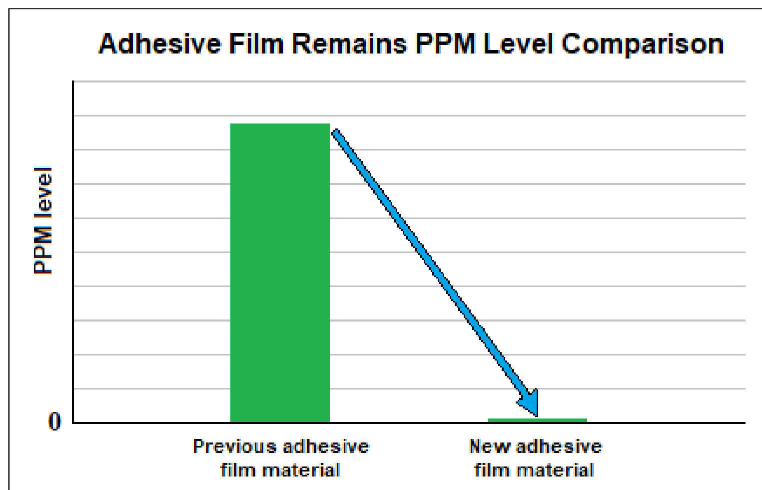

Fig. 5. PPM performance

Another advantage of the solution is the good adhesion on the leadframe and a better reliability response of the product. The incorporation of the new adhesive film and dicing tape makes a stronger adhesion between the two materials resulting to non-separation of the film. The improved material also has better thermal conductivity compared to the previous one. Comparison in Fig. 5 in terms of parts per million (PPM) level shows improvement with the improved adhesive film material during pick-up process of silicon die in the wafer tape. Actual PPM values are intentionally not given, instead, visual comparison is shown.

4. CONCLUSION AND RECOMMENDATIONS

The paper presented a process solution and improvement with the improved die attach

adhesive film, which significantly removed the occurrence of the top contributor assembly reject, that is the adhesive film remains during pick-up of silicon die in die attach assembly process. The improved material offered better adhesion on the semiconductor carrier and better reliability response.

Based on this study, it is recommended to have this type of adhesive film to remove and totally zero-out the issue of adhesive film remains in the die attach process during pick-up. For future works, in-depth comparison of the materials as well as the failure mechanism are essentially helpful to determine the true root-cause of the defect and to validate the effectiveness of the change in material. Note that continuous process and design improvement is necessary to maintain high quality performance of assembly manufacturing. Studies in [1-3,11-12] are helpful in deeply understanding the material and its experiments and to improve the die attach process.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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