



Die Attach Film Bleed out Resolution through Process Optimization on DFN Packages

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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

The development of new technology with thinner and smaller packages has become the movement and focus on semiconductor assembly industry. This paper presents an improvement done in dual-flat no-leads (DFN) package to resolve the quantity of rejection due to die attach film (DAF) bleed out on the die paddle of the leadframe. This reject manifestation was seen after die attach process. Parameter optimization particularly for the bonding with the combination of bond force and bond time parameter was done to eliminate this type of issue after die attach process. With this die attach process optimization and improvement done, DAF bleed out occurrence was eliminated with 100% reduction improvement.

Keywords: Bleed out; DAF; DFN; die attach process; leadframe.

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1. INTRODUCTION

Nowadays, technology is getting more advanced that every sector of the business requires electronic products to help simplify all things for the benefit of the business through faster deliveries, efficient work process and excellent quality. Electronic products composed of thinner and smaller packages inside an integrated circuit (IC) have experienced rising demand in the semiconductor industry. New technologies like in dual-flat no-leads (DFN) platform have faced manufacturability issues, and one of the assembly processes mostly affected is the die attach process. Die attach process or diebonding is responsible in the picking and bonding of individually sawn silicon die from a wafer tape to the leadframe or semiconductor carrier. This paper is focused in improving the die attach process and providing a solution in preventing a die attach process reject which is the die attach film (DAF) bleed out. The paper discussed the improvement done by optimizing the die attach process parameters namely bond force and bond time. Bond force is the amount of additional pressure applied during the bonding cycle while bond time is the duration applied through bond force with heavily pressed on the die paddle of the leadframe material. To guarantee its integrity

during lot processing, die attach process is incorporated with several specification criteria such as bond line thickness (BLT), die placement, die shear test and visual inspection. These criteria are performed after machine setup and conversion to ensure the product is reliable when subjected to reliability test. Fig. 1. shows the actual DAF bleed out defect manifestation.

A complete assembly process flow for DFN semiconductor package from pre-assembly to singulation is illustrated in Fig. 2. Important to note that assembly process flow varies with the product and the technology [1-4]. Furthermore, with new and continuous technology trends and breakthroughs, challenges in semiconductor assembly manufacturing are unavoidable [5-9].

DAF bleed out is the top major assembly reject in die attach process, and this was seen during the lot processing of the package. This occurrence is caused by a high bond force and a prolonged bond time during attaching of silicon dies on the leadframe. One of the challenging issues in die attach is to process the overhang die on the paddle of the leadframe and to fine tune the parameter to have a good response in the actual unit.

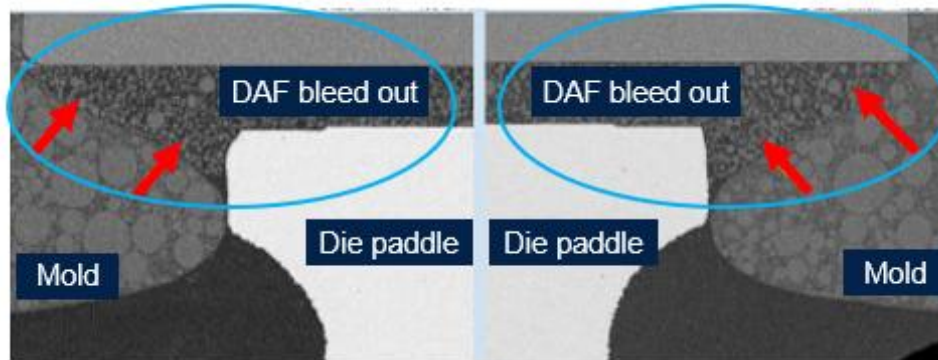


Fig. 1. Actual DAF bleed out defect manifestation

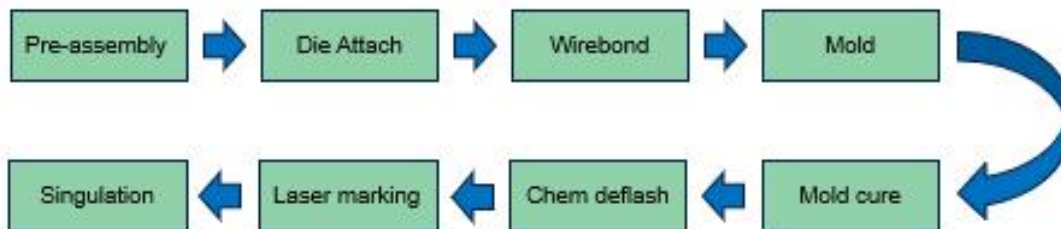


Fig. 2. DFN assembly process flow

2. PROCESS DEVELOPMENT SOLUTION

An improved process solution in die attach process is achieved with the combination of bond force and bond time parameter optimization. Fig. 3 illustrates the die attach process structure. The adhesive material used in this package is a conductive DAF, which is commonly used in the semiconductor assembly manufacturing.

With the combination of bond force and bond time parameter optimization, no DAF bleed out incident was seen after implementing the improvement in die attach process. Fig. 4 shows the actual unit with no DAF bleed out using the optimized bond force (BF) of 1 Newton and bond

time (BT) parameter of 100 milliseconds. With this improvement, 100% visual inspection is not anymore needed, and the actual unit per hour (UPH) will also increase. Additionally, a faster delivery of units and business movement could be maximized. The optimized parameter would eventually have a good reliability test and a good BLT performance. The optimized bonding parameters would result also to a good die shear test. A 100% improvement highlighted in Fig. 5 was achieved for DAF bleed out occurrence elimination. Note that actual parts per million (PPM) level are intentionally not shown due to confidentiality, but the improvement resulted to zero (0) occurrence of DAF bleed out.

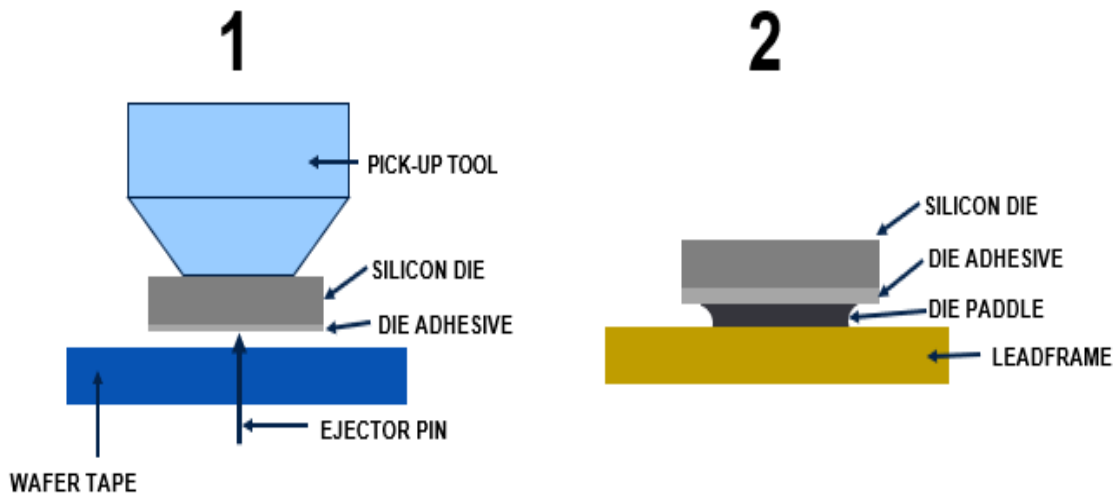


Fig. 3. Die attach process structure

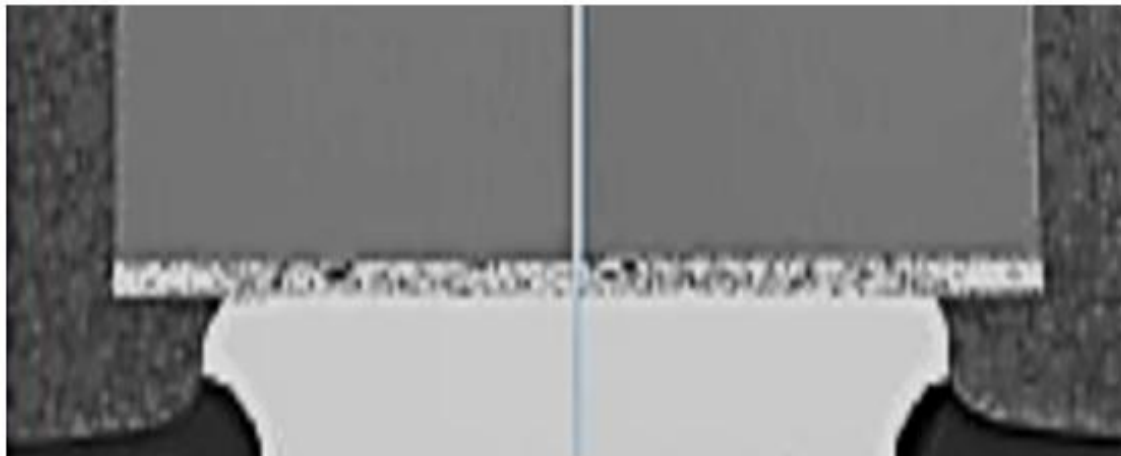


Fig. 4. Actual unit with no DAF bleed out using the optimized parameter

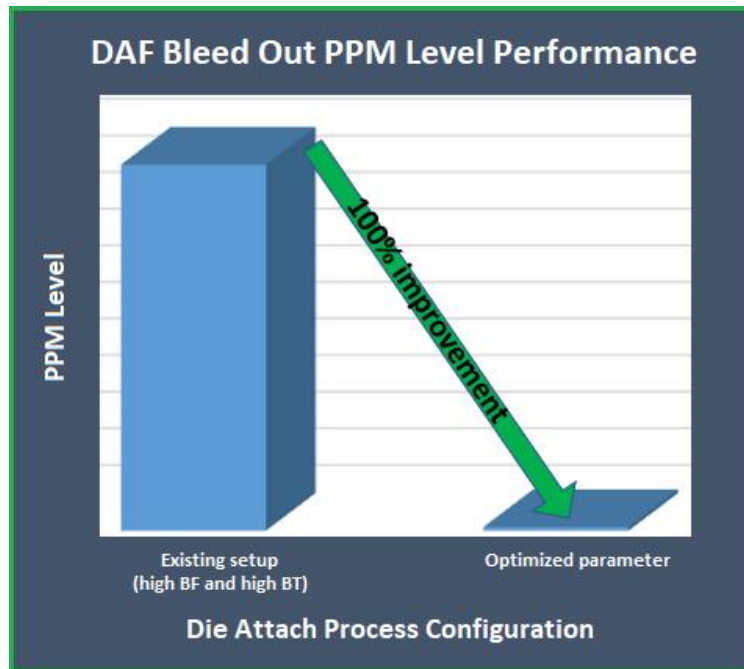


Fig. 5. PPM level performance of DAF bleed out

3. CONCLUSION

DAF bleed out was successfully realized through comprehensive die attach process characterization and optimization for DFN leadframe packages. Parameter optimization particularly for the bonding with the combination of bond force and bond time were employed, resulting to 100% improvement on the DAF bleed out elimination. The die attach parameter optimization in this study could be used for future works on other DFN products with similar configuration.

For succeeding works and studies, comparison of existing works should also be included for added analysis. Some mathematical and computer simulations could also be done for validation. Studies and learnings shared in [5-6, 10-12] are useful for improvement in the assembly processes particularly the die attach process. Worth to note that continuous improvement is important for sustaining the quality excellence of any product and of the assembly manufacturing plant.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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