Conceptualized Improvement on Transparent Glass Die for a Robust Manufacturing Process

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Authors’ contributions

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

Article Information

DOI: 10.9734/JERR/2021/v20i617326

Received 26 February 2021
Accepted 04 May 2021
Published 07 May 2021

ABSTRACT

Glass die are one of the materials used by semiconductor plants during production of specialized quad-flat no-leads (QFN) products. With its transparent appearance and fragile characteristics, several challenges are encountered and analyzed to resolve unwanted issues and to have a robust process manufacturing. This paper will discuss a potential concept of process improvement on the side of the device’s manufacturing with pattern recognition capability as detection and identification of the material to be processed. The paper will also discuss different options that can be selectively considered with respect to the manufacturer’s capability of their process flow.

Keywords: Glass attaches process; glass die; pattern recognition system; QFN.

1. INTRODUCTION

In package assembly of semiconductor products, technology and miniaturization has been one of the key factors of innovation for QFN devices. These devices were designed for commercial and industrial use around the world, with different materials and techniques that were considered by manufacturing plants to obtain a fully functional product that will serve its purpose.

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effectively and with quality. Worthy to note that with new and relentless technology trends and breakthroughs, challenges in assembly manufacturing are inevitable [1-4].

A specialized QFN device discussed in this paper is designed to isolate sections or branches of electricity in a system, mainly to prevent current flow, or restrict its direction on a certain path. In the assembly of this device, glass die is used as a direct material during glass attach process to separate current flow of two semiconductor die. Glass attach is a semiconductor process wherein glass die from singulated glass wafer with adhesive material underneath will be picked by a glass attach machine and placed it above a die to isolate from another die [5,6]. These pick and place modules in glass attach machines uses pattern recognition system (PRS) as their vision system to be able to detect the material to be picked and place it on the desired area with accuracy and precision. Works and studies related to the vision system are shared in [1-4,7]. As seen on Fig. 1, PRS of the machine works by recognizing the material and uses it to align the picking process. It functions on the material that will be taught using its appearance including shape, size, and unique pattern. After teaching the learned image of the material will be stored on the machine’s system and if seen by the camera, it can recognize based on what was taught. Same goes with placing the material on the desired location with accuracy and correct position [8-10].

Having this transparent glass die without a unique pattern contributes to an unstable process due to its characteristics cannot clearly recognized by the PRS through the camera of the machine, that contributes to rejection and unwanted machine downtime like recognition failures and minor assists that makes the machine stop unintentionally. Errors during recognition of glass die on wafer pickup and glass attach occurs frequently, or eventually bypassed to proceed the process sequence resulting to bad glass attach positioning as shown in Fig. 2. In resolving this phenomenon, an improvement will be considered by conceptualizing a solution that will enable PRS to fully recognize the material, and to eliminate wastage caused by scrappage and unwanted downtimes.

2. MATERIAL DESIGN IMPROVEMENT AND SOLUTION

The concept of fiducials or unique pattern on materials and tools have been used by most manufacturing industry utilizing pattern recognition system for machines and instruments. On die attach process, they are used as measures for determining specific die placement and position. Using fiducials on the material for the PRS to detect and recognize, it will introduce a more robust process that does not limit machine capability and technical competency of machine technician. Fig. 3 shows the current design of the device in focus using glass wafer, and position of glass die on the package.

Conceptualized improvement for this QFN package is to use fiducial on glass die, for a better PRS recognition. As depicted on Fig. 4 with fiducial present within the periphery of the glass area, PRS can easily detect and perform accurate and precise pick and place process.

![Fig. 1. Pattern recognition of glass die post glass attach](image)
Fig. 2. Glass misalignment during glass attach

Fig. 3. QFN device using transparent glass die

Fig. 4. Glass die with fiducial on 2 corners
Another selection recommended in complementary with fiducials is the visible saw lane as highlighted in Fig. 4, which gives emphasis on the glass area and makes it more detectable. Fiducial combined with saw lane or glass outline defined as the visible line of the die used by sawing process, does not only improve the glass attach process, but also the downstream and upstream stations of the manufacturing like wafer sawing and wire bonding process which both uses PRS. The more visible the product is with the help of these fiducial and saw lane or glass outline, the more accurate it can be recognized by the machine during processing.

3. CONCLUSION

The introduced concept of fiducials and visible saw lane on glass wafer for this QFN package will give a significant improvement in detection and recognition of PRS during glass attach process. Having a consistent machine PRS detection with the help of these innovative solution will contribute to more efficient and robust process, eliminating machine downtimes and unwanted rejects as it targets to pick and place the material with accuracy and precision. The more it recognizes clearly and accurately, the more it will produce good units and desired yield will be achieved. With this innovative concept, it is therefore recommended to be applied on equivalent materials and processes that experience the same phenomenon. Opportunities for improvement is also essential and worth considering as technology and innovation does not stop but continue to overcome technical difficulties of manufacturing industry.

DISCLAIMER

The products used for this research are commonly and predominantly used products in our area of research and country. There is absolutely no conflict of interest between the authors and company because we do not intend to use this company as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the company rather it was funded by personal efforts of the authors.

ACKNOWLEDGEMENT

The authors would like to thank the Operations 1 Assembly Pre-Production Group (PPG) team, the New Product Development & Introduction (NPD-I) team, and the Management Team (MT) for the unwavering support.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:
The peer review history for this paper can be accessed here:
http://www.sdiarticle4.com/review-history/67864