Eliminating Frequent Machine Assists through Process Plate Enhancement on Wirebonding Process

Jonathan Pulido[1*], Edwin Graycochea Jr.[1] and Frederick Ray Gomez[1]

[1]*New Product Development & Introduction, STMicroelectronics, Inc., Calamba City, Laguna, 4027, Philippines.*

Authors' contributions

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

Original Research Article

ABSTRACT

New devices and technologies in the semiconductor industry are getting more challenging to process because of inherent issues especially on quad-flat no-leads (QFN) packaging assembly. This paper is focused on the improvement done for QFN leadframe device to address the major machine assist during the lot processing at wirebond process. Illumination and visual of the leadframe and the sand blasting process plate on the machine are difficult to separately distinguish due to similar color shade of the materials, thus frequent machine assists ensued. To reduce the frequent machine assist occurrence, an improvement is done through enhancing the process plate by using a black chrome to totally separate the illumination of leadframe and the process plate. Ultimately, the machine assist during wirebonding process is improved (the longer the better) from 16 minutes to 6 hours continuous and uninterrupted running.

Keywords: Machine assist; pattern recognition; process plate; QFN; wirebonding.

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Corresponding author: Email: jonathan.pulido@st.com;

1. INTRODUCTION

Semiconductor QFN device is one of the mainstay integrated circuit (IC) packages in semiconductor assembly manufacturing industry. The fast-paced growth on this package provides the need for every industry to come up with more innovative packaging solutions to stay competitive in the market. However, issues were encountered in wirebonding process and these are unavoidable. This paper is focused on the machine error with major assist resulting to long downtime. Actual photo shown in Fig. 1 pinpoints the actual sand blasting process plate and actual machine error. This paper presents an improvement to process this type of technology in wirebond process by using a black chrome process plate. The black chrome process will separate the illumination of the leadframe and process with black and white pattern recognition (PR) on the said device.
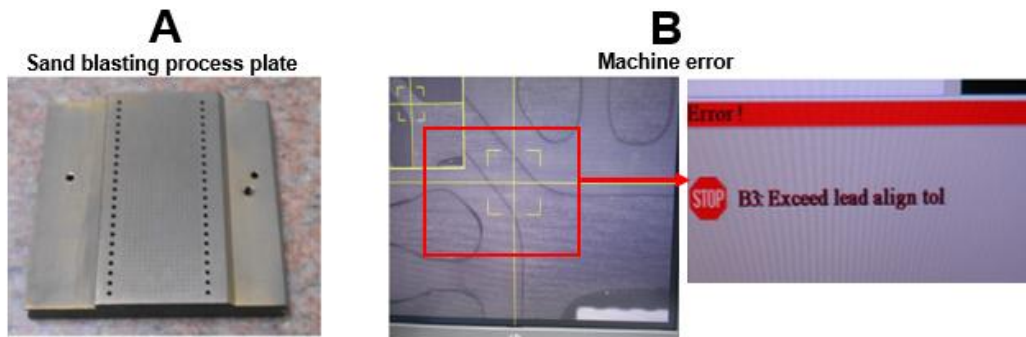

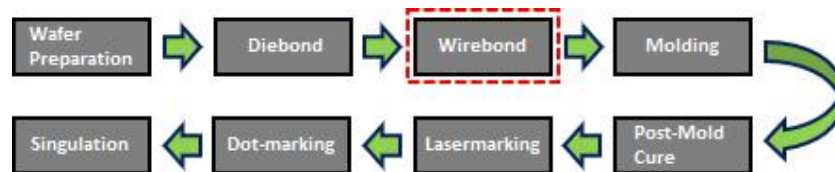**Fig. 1. A) Actual process; B) Actual machine error**


Fig. 2. Assembly process flow

A process macro map for the QFN device in focus starting from pre-assembly or wafer preparation to singulation process is shown in Fig. 2. Highlighted is the process where the issue was encountered. Worthy to note that assembly process flow varies depending on the product and the technology. Also, with the continuing technology development and state-of-the-art platforms, challenges in semiconductor industry are inevitable especially on wirebonding process [1-5].

Major machine assist downtime is the main occurrence during lot process of the QFN device. This is caused by a sand blasting process plate because of the pattern recognition of the leadframe versus the process plate. Pattern recognition system is a typical capability of machines for proper detection, inspection, and processing [6-11]. The illumination of the leadframe and the process plate were commonly the same and the machine cannot recognize the leadframe itself resulting to frequent machine error with 16 minutes continuously running. With this problem, an improvement is done by enhancing the process plate finish to black chrome to totally separate the pattern recognition of the leadframe and the process plate with black and white illumination.

2. METHODS AND RESULTS

With the improved and enhanced process solution, in wirebond process is extremely resolved the machine assists downtime by using a black chrome process plate as shown in Fig. 3. With leadframe on top and a good pattern recognition between leadframe and black chrome process plate. With this improvement, no major long machine downtime occurrence after implementing this improvement. One of the advantages of the solution is the unit per hour (UPH) is increased because the machine is continuously running about 6 hours with no error

A

Black chrome process plate

B

Leadframe   **Black chrome process plate**
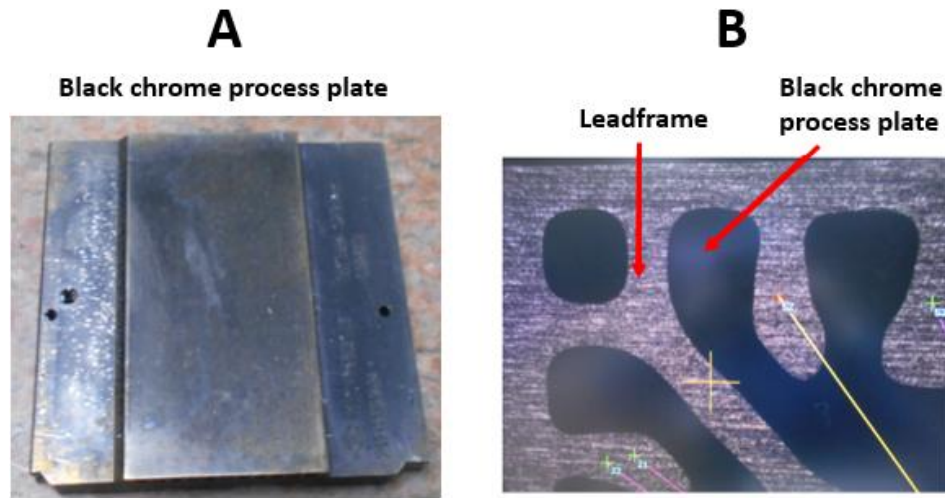
Fig. 3. A) Black chrome process plate; B) Actual leadframe with good pattern recognition

encountered using black chrome process plate. Another advantage of this improvement was the operator can assist another machine to speed up delivery from another device to sustain the assembly commitment to our customers.

3. CONCLUSION

The paper discussed a process solution and improvement in addressing the frequent machine error with long machine downtime at wirebond assembly process. For full automation, ideally there should be no manual/human intervention during operation. This is also to maintain/increase the UPH output of the machine. The sand blasting process plate is one of the common and readily available plates during the qualification of the device. However, it was found out that the process plate and the leadframe material has the same color shade hence it is difficult for the machine identify which is which. This causes the machine error during the operation. Now, by using a black chrome process plate especially for QFN device, the machine assist occurrence was successfully mitigated by correctly identifying the leadframe part, with 6 hours uninterrupted machine running unlike using the sand blasting process plate with only 16 minutes of continuous operation. The improved solution is considered a key milestone which could be used for future reference in wirebonding process for QFN device.

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 producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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