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Die Attach Pick-up Tool Design Studies for DAF Voids Elimination

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Abstract— *As consumers market continue to push electronics manufacturers for smaller yet higher functioning products, packaging engineers must keep pace with the development of devices that can meet these demands. The main drivers for Die attach film (DAF) implementation are package miniaturization and die thickness reduction, especially in applications requiring thin die thickness. However, processing of DAF materials presents certain difficulties, especially in Die Attach Voids issue. This article tells the challenges in terms of die attach tooling and processing optimization to incorporate DAF into the assembly of a thin die in Ball Grid Array (BGA) package. Die Attach Pick-up tool characterization with material modification was conducted to provide insights on influence of the design of Pick-up tool on DAF voids. To achieve void-free lamination, it was found that Pick-up tool with distributed vacuum hole design to avoid die bending.*

Keywords— *DAF Voids; Die Attach; Die Attach Film; Delamination; Pick-up Tool.*

I. OVERVIEW

Die Attach Film (DAF) in Fig 1. is an alternative to die attach paste which offers a much more streamlined process. An alternative to die attach paste which offers a much more streamlined process. Compared to pastes which during die placement and stacking, which is more time and equipment intensive. New generation of DAF tape incorporates wafer dicing tape and adhesive in one, namely the Dicing Die Attach Film (D-DAF), which is mounted onto the back of wafer. The wafer which is mounted with DDAF will be diced into the predetermined die size and the diced chip will be picked and placed directly to a leadframe or substrate with adhesive at the back.

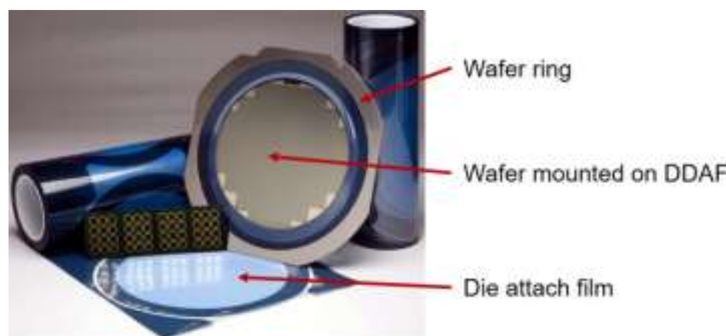

Fig. 1. Die Attach Film

Sample of Cross-Section BGA package can be seen in Fig. 2. There are two common adhesive material used for die attach in the microelectronic packaging i.e epoxy paste and die attach film (DAF). The application of DAF for die stacking is well documented as a standard die bonding material. Challenge in controlling the DAF voids effect to the product reliability need an advanced solution for optimum performance.

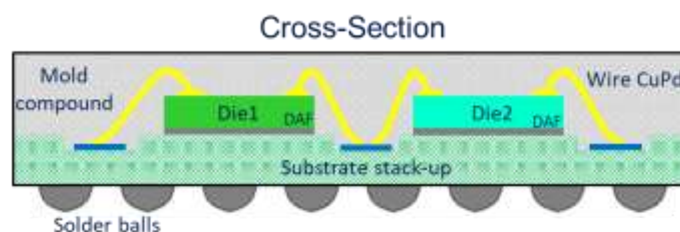

Fig. 2. BGA Cross Section

II. PROBLEM IDENTIFICATION

After Die Attach assembly, all units were checked for time-zero delamination using a Scanning Acoustic Microscope (SAM) operating in transmission mode. In the transmission mode, any air gap will show up as a black area in the SAM image in Figure 3.

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Typical Optical images comparing units with DAF voids are also shown in Figure 3. From SAM analysis, time-zero delamination was detected, Subsequent cross-section analysis confirmed that there is a DAF voids or delamination between DAF and substrate as shown in Figure 4. Hence, these DAF voids or delamination were rejected from further assembly and testing to avoid complications such as probability to initiate popcorn failures during MSL3 preconditioning.

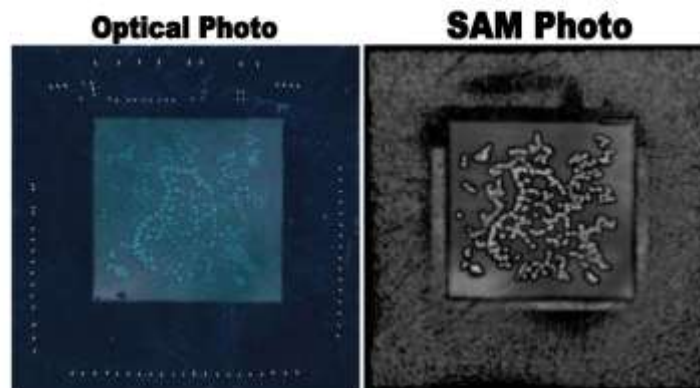


Fig. 3. Optical and SAM Photo of DAF Voids

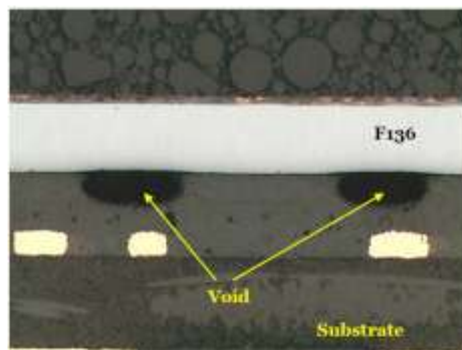


Fig. 4. DAF Voids in Cross Section Unit

III. Assembly Process Improvement

One of the solution is to Evaluate and verify different design of Pick-up tool in Die Attach and the effectiveness to address DAF Voids or delamination as shown in Figure 5.

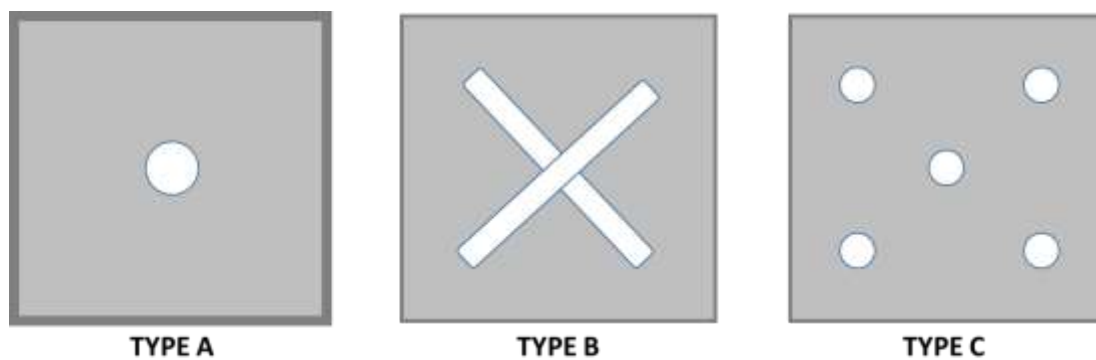
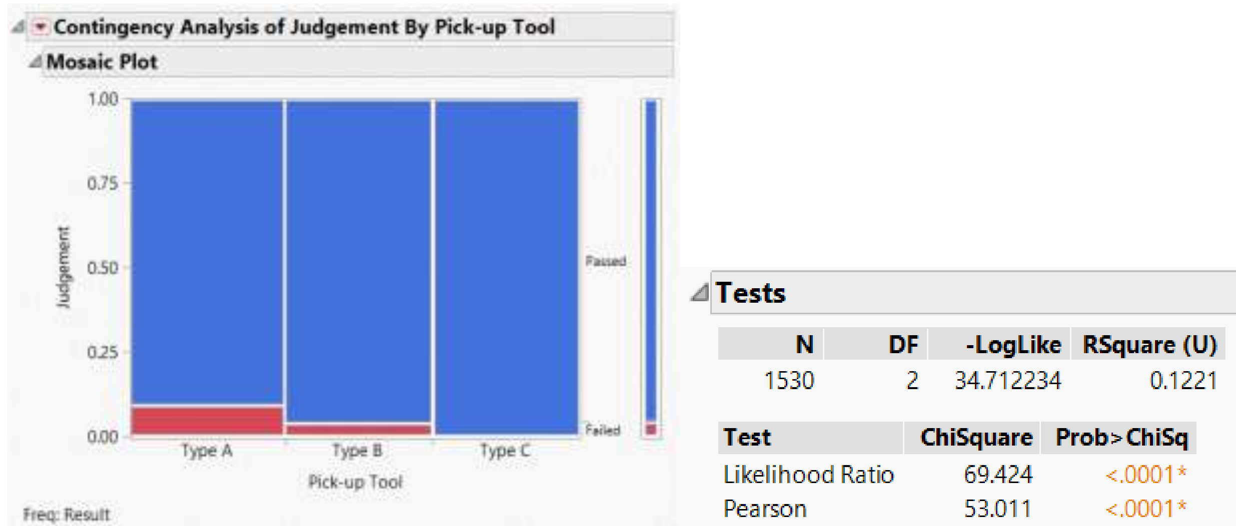


Fig. 5. Deferent Die Attach Pick-up Tool Design

Using the Statistically 2 Proportion test in Fig. 6, there is Significant difference with Type C Pick-up Tool in response in DAF Voids with P value of <0.001 as shown in Figure 7. No DAF Voids occurred by using Type C Pick-up tool.



N	DF	-LogLike	RSquare (U)
1530	2	34.712234	0.1221

Test	ChiSquare	Prob>ChiSq
Likelihood Ratio	69.424	<.0001*
Pearson	53.011	<.0001*

Fig. 6. DAF Voids Statistic Test Result

Overall result shows, Voiding can be minimized through the use of Pick-up tool with distributed vacuum hole design. Vacuum holes were distributed to avoid die bending. In summary, this study demonstrates that good processibility and robust performance with DAF can be achieved with proper material selection and optimized process parameters. Based on the results, it is highly recommended to Pick-up tool with distributed vacuum hole design as shown in Fig. 7.

Fig. 7. DA Pick-up tool with distributed vacuum hole design

REFERENCE

[1] Diebond Machine Process Capability Study, July 2010.