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Enhanced cDAF Material: A Process Improvement for Die Attach focusing on Die Shear Strength

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Abstract — *New material technologies like conductive die attach film were introduced in order to cater packages with high thermal and electrical requirements. However, these materials creates several problems during its manufacturing assembly. Conductive Die Attach film needs a good adhesion from the die backside and the carrier die paddle to ensure good electrical conduction. The paper discusses the improvement done on the material in order to increase its adhesion strength.*

Keywords— *Dual Flat No Leads package; Process Plate; leadframe vacuum; semiconductor package; process solutions*

I. INTRODUCTION

Die Attach Films or DAF are the major technology developed in order to improve the growing needs for semiconductor packages miniaturization. Die Attach Film are applied to the wafer backside prior to wafer saw which enables the availability of an adhesive material prior Die attach process, hence removing the need of epoxy dispensing process [1]. Several applications of Die Attach film is Chip on Lead application and packages with limited die paddle. DAF come in the form of pre-cut, which the supplier cut, into the shape of the wafer and pre-laminated onto the wafer mounting [2]. DAF can be non-conductive and thermally and electrically conductive to support the needs of electrical connection of the wafer backside and the lead frame paddle. In order to improve the electrical and thermal conductivity properties, there is a need to add fillers, like Silicon Carbide, also to improve its bonding strength [3]. However, the introduction of Die Attach Film have several potential stability problems such as package crack, moisture absorption, adhesive strength, elastic modulus, glass transition temperature (Tg) and coefficient of thermal expansion (CTE) [4].

Key Processes that was involved on the development of Die Attach Film are the Wafer Mounting and Die Attach. Die Attach process of bonding the silicon die into the carrier via an epoxy adhesive. On this paper, the main epoxy adhesive used was conductive die attach film. As shown in Figure 1, the package architecture was composed of a bare copper lead frame at the bottom then been adhered by a conductive die attach film in between the silver spot die paddle and silicon die.

Fig. 1. Package Architecture

The main process involves mounting of the wafer into the conductive die attach film then sawn into the preferred die sizes. The sawn dies will then be picked from the wafer frame and place into the preferred carrier, either lead frame or substrate. As previously discussed, one of the possible main problem that cDAF can incur was the lesser die shear strength. Shear strength is mainly measured by a method called Die Shear, wherein a cured material was been sheared in order to measure the adhesion strength of the epoxy with respect to its silicon die and carrier interface. The main problem that we might encounter was no adhesion at die paddle. Figure 2 shows the no epoxy adhesion phenomena with respect to die paddle.

Fig. 2. No Adhesion on Paddle

The paper will discuss the improvement done on the conductive die attach film in order to improve its die shear strength and therefore a good cohesion between silicon die and lead frame interfaces.

II. PROCESS SOLUTION

In order to improve the adhesion strength of the silver spot die paddle and silicon die interfaces, several factors was considered and evaluated. The paper will manifest the effect of enhancing the conductive die attach film material through increasing the silver loading of the conductive die attach film. Based on study, silver-to-silver adhesion is better than the

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polymer to silver spot die paddle. Higher silver loading of the conductive die attach film also helped increase the electrical and thermal performance of the semiconductor package. In terms of die attach process, as shown in Figure 3, silver to silver adhesion have increased for almost doubled its die shear strength, an increase of almost 4kgf was manifested. The failure mode also shows that there were a good cohesion of the adhesive into the paddle hence a good adhesion then latter improve the reliability of the semiconductor package. Higher Silver Loading conductive die attach film therefore help improve the die attach process characteristics.

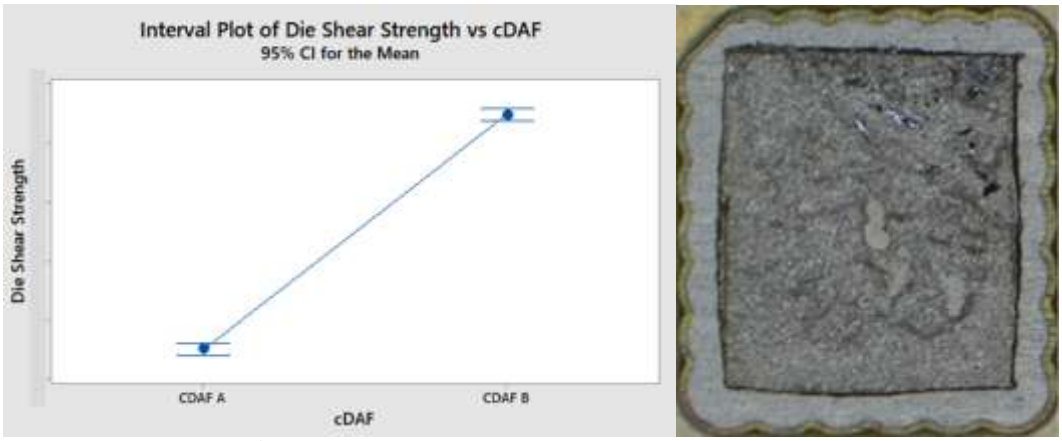

Fig. 3. a. Analysis of Variance on two cDAF type b. Cohesive Adhesion on Paddle

III. CONCLUSION

The material improvement of increasing the silver loading of a die attach film thus will help improve the adhesion of silver towards its silver spot die paddle lead frame. An expected increase of twice of its original die shear strength and improvement in terms of die shear failure mode thus makes the semiconductor package reliable and market ready. The conductive die attach film also help improve the thermal and electrical performance of the package. The improvement in terms of its material composition have no significant impact to its process ability thus making more industrial ready. The combination of electrical performance and the advantages of die attach film for limited die paddle will also help the package miniaturization target of most of semiconductor package manufacturers.

REFERENCES

[1] Cheung, A.T., Dicing Die Attach Films for High Volume Stacked Die Application, Institute of Electrical and Electronics Engineers 2006
[2] Hwa, K.L., Erfe, E., Wan, C.M., Robiatum, S.S., Man, J.L.S, A Comparison Study of Different Wafer Backside Coating Technologies, 36th International Electronic Manufacturing Technology Conference, 2016
[3] Duan Y., Lilei, Y., Cui, H., Liu, J. A New Thermally Conductive Thermoplastic Die Attach Film, Institute of Electrical and Electronics Engineers 2012
[4] Guan, C., Li, M., Chen, H., Effects of Moisture Absorption and Temperature on the Adhesion Strength between Die Attach Film (DAF) and Silicon Die, Institute of Electrical and Electronics Engineers 2012 Inc