



Addressing Off-Centered Ball through Solder Paste Material Evaluation

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Authors' contributions

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

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ABSTRACT

Stencil printing using solder paste material is one of the challenging processes in semiconductor assembly manufacturing. During evaluation of a semiconductor device, off-centered ball issue was encountered. The study aimed to mitigate the off-centered ball issue at stencil printing process by exploring the effect of different solder paste materials. Both solder paste materials were cured using the same reflow condition. However, solder paste material 1 (S1) resulted to cold solder joints while material 2 (S2) showed cured solder paste characteristic. With S2 material used in stencil printing, the off-centered ball occurrence was eventually eliminated. For future works, the solder paste material and configuration could be used for devices with similar requirement.

Keywords: Ball attach; off-centered ball; solder paste; stencil printing.

1. INTRODUCTION

Semiconductor ball grid array (BGA) devices with solder balls for external interface or connection

would require solder paste printing process wherein the solder paste material is applied below the device using stencil printing. Application of the technology with solder balls on a specialized

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leadframe device results to manufacturing challenges, especially as the stencil printing is used for the solder ball creation. Generally, with new and continuous technology trends and breakthroughs, challenges in assembly manufacturing are inevitable [1-4]. A specialized leadframe device in Fig. 1 has high-density of input/output (I/O) signals and requires the stencil printing for solder paste process.

A typical assembly process flow for the device in focus is given in Fig. 2. Important to note that assembly process flow varies with the product and the technology [5-8]. The process in focus for the study is the stencil printing for solder ball attach.

During the stencil printing process, one of the issues encountered is the off-centered ball as illustrated in Fig. 3.

One cause of the off-centered ball is the viscosity of the solder paste material, aside from alignment issues due to warpage. The existing solder paste material (S1) showed a colder or uncured characteristic as seen in Fig. 3. Machine parameter

optimization was done but the issue off-centered balls still occurred. With this, further study on new solder paste material evaluation was done.

2. METHODS AND RESULTS

One factor that contributed to the off-centered ball issue is the type of solder paste material. Two solder paste materials were evaluated for stencil printing – 1) previous or existing solder paste material (S1), and 2) new solder paste material (S2). Both solder paste materials were cured using the same reflow oven profile as shared in Fig. 4.

With the improved design using S2 with low viscosity, the solder ball formation greatly improved as shown in Fig. 5. The material S2 showed cured solder paste appearance, as compared to S1 with colder solder joints characteristic. Another advantage of the solution is that S2 has higher thermal and electrical response compared to S1 as indicated in their respective data sheets.

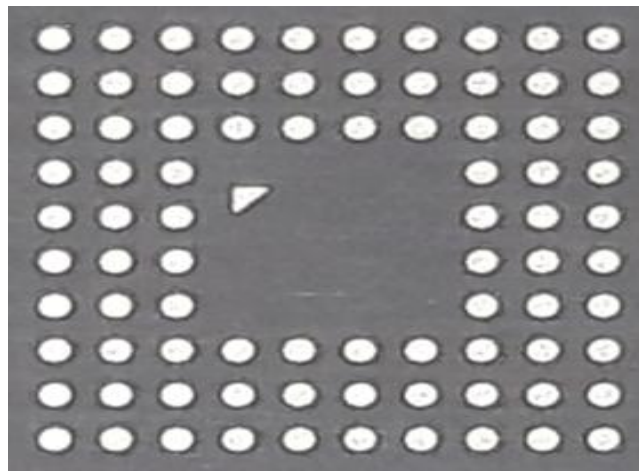


Fig. 1. Bottom view of device for ball attach

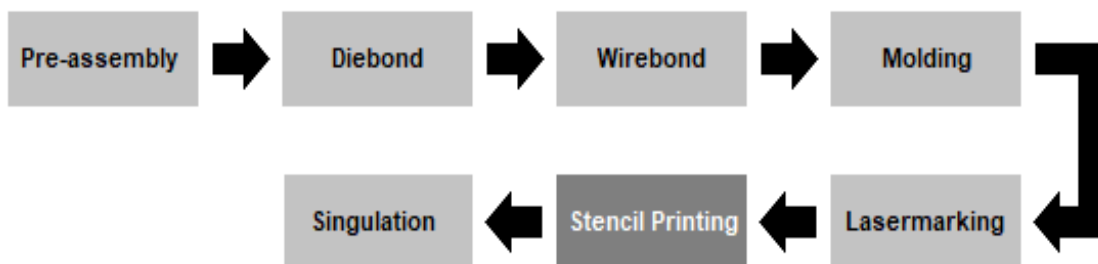


Fig. 2. Assembly process flow of the device in focus

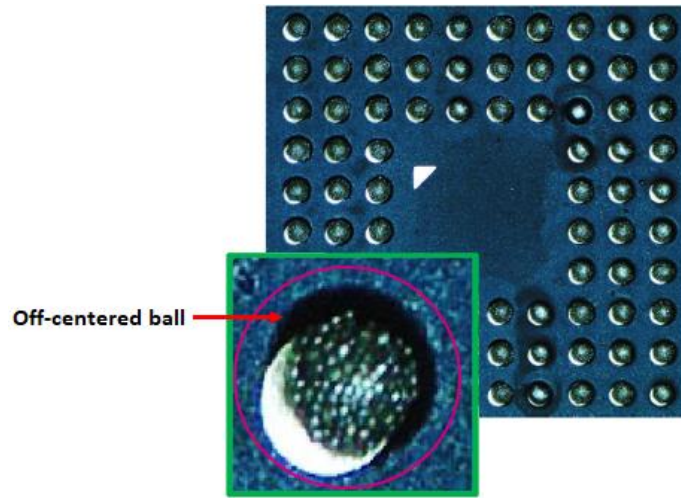


Fig. 3. Off-centered ball defect

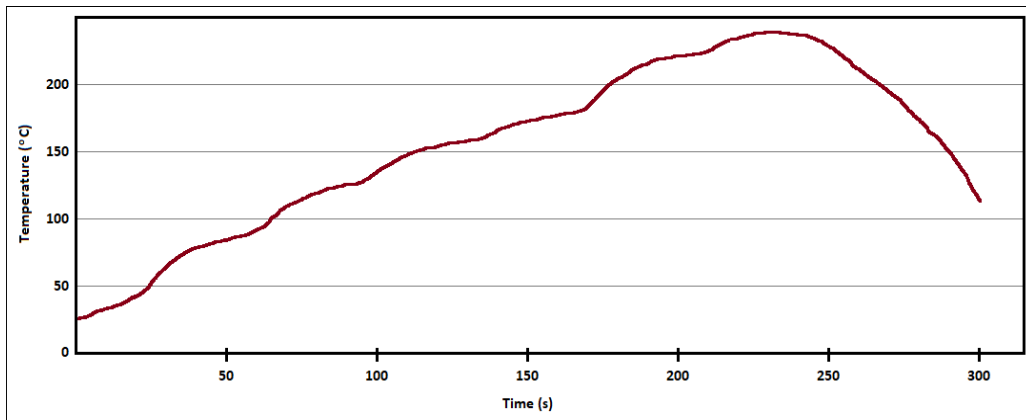


Fig. 4. Reflow oven profile

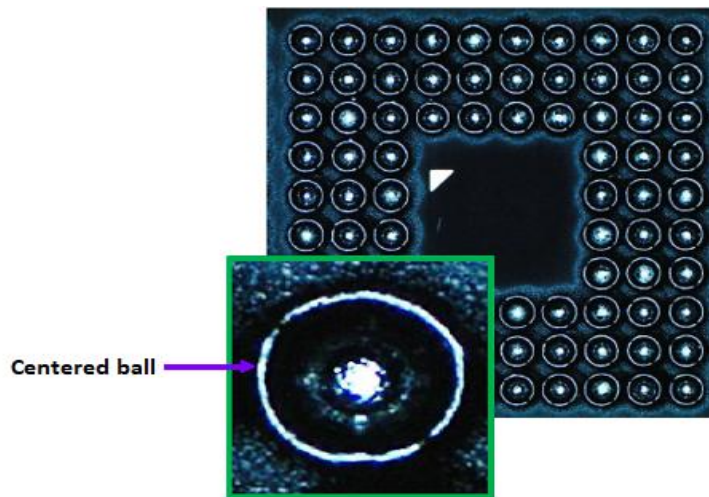


Fig. 5. Good ball formation

3. CONCLUSION AND RECOMMENDATIONS

Material selection and evaluation is critically important during qualification of semiconductor device. The paper presented a study on two solder paste materials for stencil printing process during the development of a specialized leadframe device. Off-centered ball occurrence was mitigated after the application of the new solder paste material S2. For future works and studies, the S2 material could be used for devices with similar configuration.

Comparison of existing works and previous studies is recommended for added analysis. Worthy to note that continuous process improvement is really important to maintain the high quality performance of semiconductor products and its assembly manufacturing. Studies and learnings discussed in [9-12] are helpful in with regards to the solder ball attach process and assembly manufacturing in general.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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