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Foreign Material Removal through Optimization of Vacuum and Blow FM Kit

Michael D. Capili
Back-End Manufacturing & Technology, STMicroelectronics, Inc.
Calamba City, Laguna, Philippines 4027

Abstract— *System and method for applying a FM kit to remove the foreign material during Die Attach process through Vacuum and Blow pressure release to a surface of the semiconductor Leadframe or substrate to remove particulate contaminants or foreign material that may have been collected thereon. The Clean Dry Air (CDA) blow pressure-release to which the foreign material is adherent is peeled off or removed from the surface of the leadframe or substrate. Advantageously, a vacuum also installed in FM kit to suck the foreign material in order to increase the efficiency in removing the foreign materials.*

Keywords—*Die Attach; Foreign Material, FM Kit.*

I. INTRODUCTION

Foreign material is defined as any material that does not originate from the microcircuit or any semiconductor material that is displaced from its original or intended position within the microcircuit. Foreign particle(s) on the surface of the semiconductor die or wafer that is large enough to bridge the narrowest space between unglassivated operating material (metallization, bare silicon, etc...) The narrowest space will be either (1) between bond pads (window edge to window edge) or (2) bond pad window edge to bare silicon (except for metal that is at the same potential as the substrate), whichever is smallest.

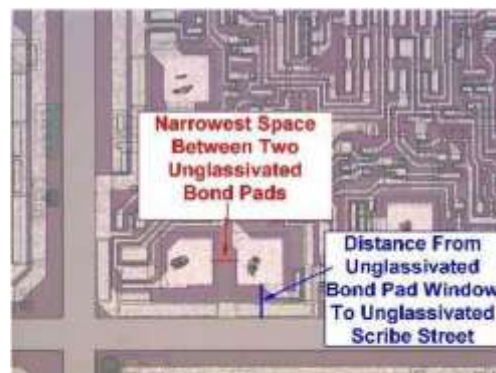

Figure 1. Example of surface of the semiconductor die or wafer

Foreign material attached to or embedded in the die surface that appears to bridge the active circuit elements including metallization unless verified as only attached but not embedded by high power dark field illumination. Below is a fiber foreign material that is bridging across several metallized and bare silicon areas.

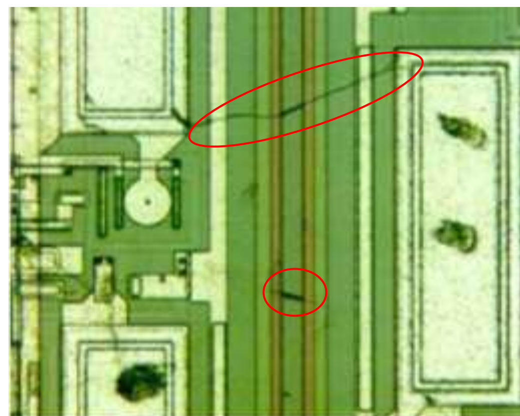

Figure 2. Example of Removable Fiber Foreign Material

II. Problem Identification

Foreign materials defined in this project are non-conductive fiber-like particles affecting mainly on semiconductor packages inviting such foreign materials to accumulate on the surface of the semiconductor material such as wafer, leadframe and substrate. These foreign materials cause quality issues during die bond or wire bond process such as epoxy tailing causing epoxy on leads and on die and insufficient epoxy and at wire bond causing nonstick on leads, nonstick on pad, and missing ball/cut wire rejects.

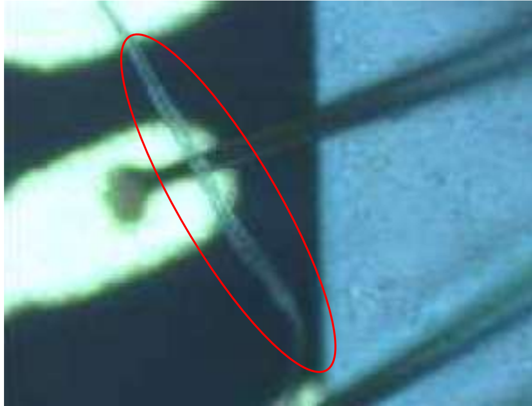
Figure 3. Fiber stick on Wire

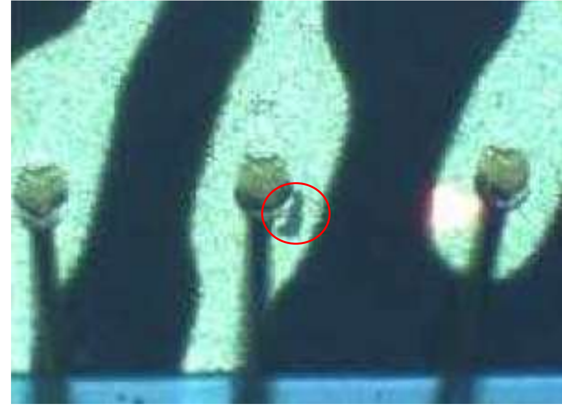
Figure 4. FM on Lead Finger

III. Assembly Process Improvement

This objective of this project is to remove the foreign material /fiber resulting quality issue through the use of blow and suck system at Die Attach process. Below is illustration of the FM Kit block diagram in Figure 5. Where the Clean Dry Air (CDA) blow pressure release from Solenoid valve to which the foreign material is adherent is peeled off or removed from the surface of the leadframe or substrate. Advantageously, a vacuum also installed in FM kit to suck the foreign material.

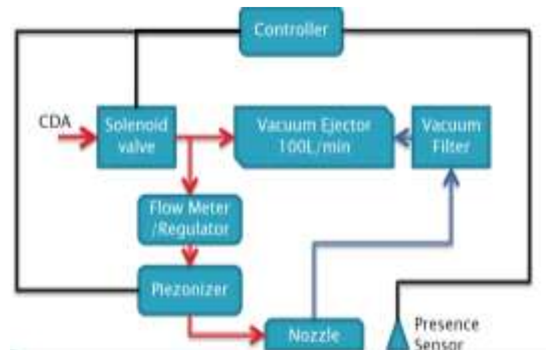

Figure 5. FM Kit Block Diagram

An inline FM kit in Figure 6, was installed in Die Attach machine prior dispense area to remove foreign material. Designed with Leadframe/substrate present sensor as inhibit function to activate blow and suction feature of FM kit. To optimize the effectivity of FM kit a Design of Experiment was performed to know the optimum setting of Air flow pressure and Vacuum pressure. And to assess the removal effectivity. Intentionally foreign material particle was place on Leadframe per Column. And place the leadframe at die bond indexer, before FM kit. Active indexing cycle & let leadframe pass through FM Kit. Count remain number of particle on leadframe sample under high power scope.

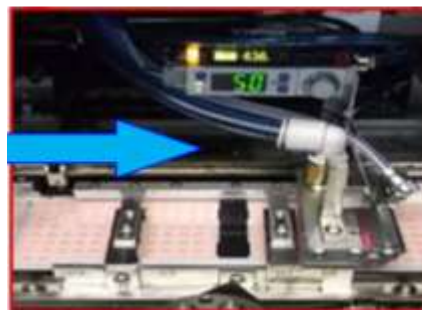
Figure 6. In line FM Kit

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As a result, JMP Design of Experiment (DOE) Prediction Profiler & Contour Profiler result in Figure 7 show Air Flow:18L/min & Vacuum Pressure: 90 kPa with achieve 95% Effectiveness foreign material removal. Also in Figure 8 the actual comparison of before and after result of in-line Foreign Material Cleaning Kit.

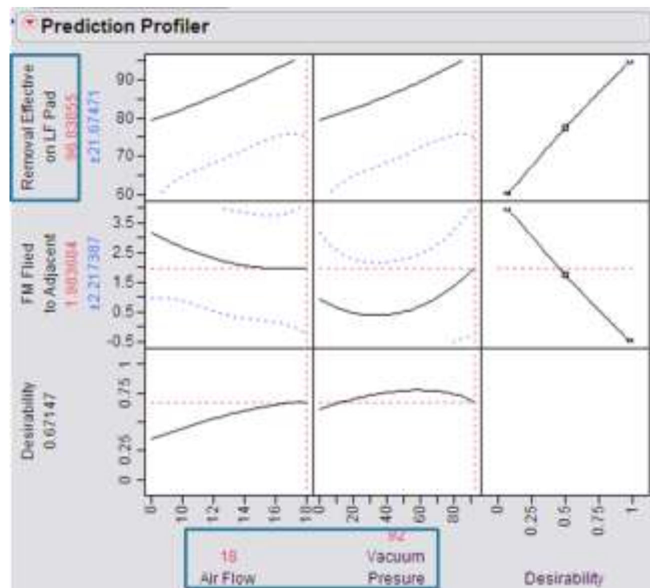

Figure 6. DOE Prediction Profiler & Contour Profiler

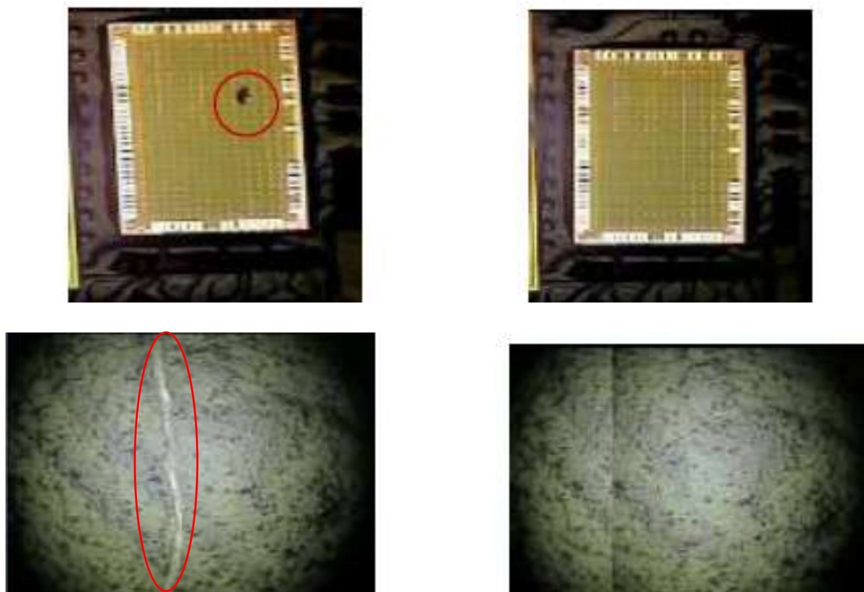

Figure 7. Before and After Result of FM Kit

IV. CONCLUTION & RECOMMENDATIONS

Using the in-line Foreign Material Cleaning Kit at Die bond machine, it is proven to solve foreign material problem causing high impact on yield improvement with 95% effectiveness.