Combining vision inspection and bare die package for high volume manufacturing

Chang'e Weng and Thorsten Saeger

TriQuint Semiconductor, Inc., 2300 N.E. Brookwood Parkway, Hillsboro, Oregon 97124

Introduction:

To ensure zero defect quality, from wafer start to final die ship, multi-point inspections are required. Current die surface inspection technologies such as 2D, 3D AOI and laser based measurement could effectively detect die/wafer surface contaminations, RP residue and bump topography. Those inspections are typically done at wafer level prior to grinding and saw.

While at die level after sawn, the challenges arise. Since die could be shifted and rotated during wafer tape expansion, complex calculation algorithm must be used to determine die position. And also due to the wavy feature of wafer tape, 100% automated inspection is extremely difficult. Moreover, it is almost impossible to inspect defects such as chipping and crack originated from backside of the die which could potentially lead to device failure.

In this paper, we will discuss an in-situ defect inspection approach during flip chip die pick & place procedure. Two major inspections include die surface inspection right before the die is ejected from wafer dicing tape and die backside inspection prior to packaging. Since the vision inspections are performed the same time as die pick & place, the cost of ownership is minimal and cycle time will not be affected.

Results and Discussion:

For both front side and backside inspections, die structure patterns extracted from a reference die image are used to determine the pass/fail of the inspecting die.

I. Die front side inspection

A vision program is configured to inspect die front side before die is picked from wafer tape. Multiple images are obtained for the inspecting die and to compare with pre-taught reference images. As shown in Figure 1, surface contamination, scratches and particles could be detected using bright filed inspection.

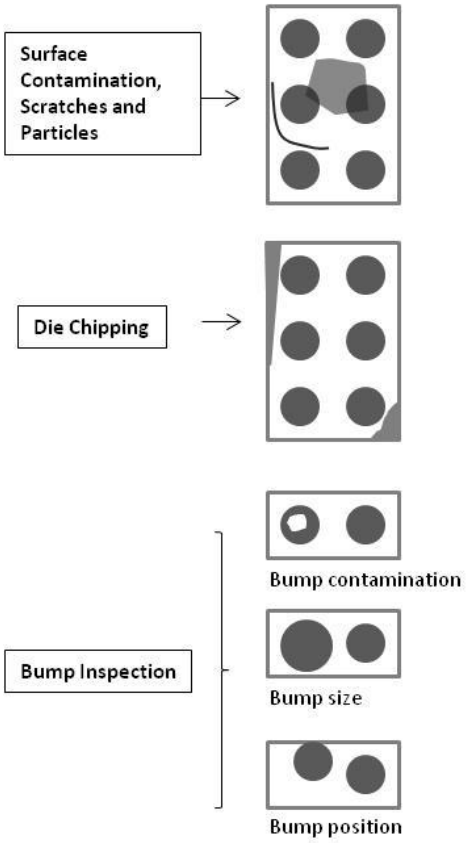

Figure 1. Examples of defect patterns.

By calculating the defect depth and total defect area, edge chipping as small as 10μm depth could be accurately detected. For bumped dies, dark filed inspection is configured to detect bump contamination, bump size variation and bump positions.

II. Die backside inspection

Backside of the die will be inspected after the die is ejected from wafer tape. Defects such as edge chipping, corner crack and backside damage could be effectively caught during backside inspection. Coaxial light is used to get the best image of the die. High quality pattern matching is used to ensure 100% defect detection. Figure 2 shows examples of backside defects inspected.

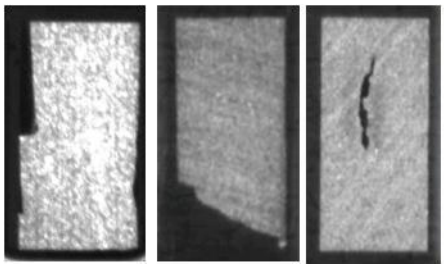

Figure 2. Examples of backside defects.

Conclusions:

100% bare die front side and backside inspection is one important step in the direction to zero defect. It ensures only good parts get packaged. In addition, defect data collected through this inspection procedure is very valuable in analyzing root causes of various defects.