Dicing Technology In Super-Thin Wafer For IC

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ABSTRACT

Following the rapid development of science & technology and more frequent communication of information, the consumptive electronic products including IC Card are tending to be more intelligent and informational. Technology in assembly of IC chips known namely as "hearts" of these intelligent electronic products has become noticeable.

Slice of silicon less than 200 μm in thickness is needed for IC Card. Dicing wafer with grinding wheel is the universal method for many IC assembly plants, but cracks on chips which are hidden trouble to IC Card in quality often occur during the dicing process.

This article gives intensive analysis and research from dicing theory and cracking causation to process improvement, at the same time it gives the effective ways to solve the problem of chip cracking by choosing appropriate dicing blade and using new dicing technique of grooving.

1. INTRODUCTION

Following the rapid development of science & technology and more frequent communication of information, the consumptive electronic products including IC Card are tending to be more intelligent and informational. Technology in assembly of IC chips known namely as "hearts" of these intelligent electronic products has become noticeable. It is well-known that IC Card is a thin slice, The thickness of the chip is required to be less than 200 μm to meet the needs of IC Card module assembling. But it is not easy to take such thin chip 200 μm in thickness out from the wafer 6" — 8" in diameter. At first, the wafer must be grinded to less than 200 μm in thickness, then diced into single chips. During dicing process, cracks on chips are the main problem which affects dicing yield.

2. PROBLEM DESCRIPTION

2.1 Cracking when Tape Attaching

For most IC Card wafer is less than 200 μm in thickness and 6-8 inch in diameter, there will be a warp in it after grinding and its strength is lower, it is easy to crack when tape is attached.

2.2 Cracking on the Face Side

The cracks occur at the grooving edge, as shown in Figure 1. The aluminum strip will break if cracks reach into it, and chip failure is caused, This case can reach over 2%. To single wafer, the severe one might reach over 10%.

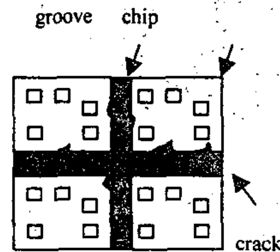

Fig 1.

2.3 Cracking on Backside

In case of normal dicing, the edge of chip back with an angle of 90 degrees will not be damaged, but in dicing process of IC Card wafer, cracks often occur on both side of groove, as sawtooth shown in Figure 2. If it is serious, a 50-100 μm long crack will be seen at the side face, as shown in Figure 3, this case might reach 10%.

chip back

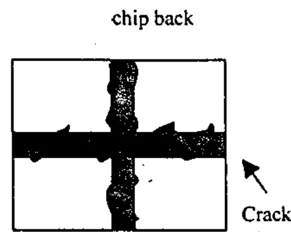

Fig 2.

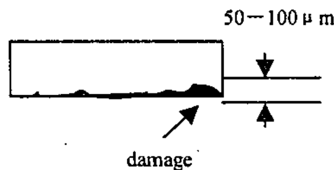

Fig 3.

3. INVESTIGATE THE TECHNIQUE OF SOLVING CRACKING PROBLEM

3.1 Using new process to solve the cracking problem when tape attached

Because IC Card wafer is very thin less than 200 μ m, and there are some ink marks on it after die sort, it is easy to crack when the roller presses forward on the wafer. The unevenness of the vacuum on the worktable is also the factor of cracking. At present, the advanced method often used is non-contact tape attaching. When a tape is attached to the wafer, there is hardly pressure on the wafer by the roller, combining the wafer with the tape by vacuumizing, and the worktable is vacuum ceramic where the distribution of vacuum is symmetrical to reduce the affect to wafer. But now many domestic factories have not this condition, so they can only improve on the primary base of machine, viz use the method of attaching tape on the backside of the wafer without ripping off the protective tape attached on the face side before grinding for increasing the intension of the wafer to decrease the affect by vacuum attaching worktable, and a cushion layer is produced to reduce the pressure on the wafer, this can prevent the wafer from cracking effectively.

3.2 Using new blade and technique to solve the problem of cracks on face side and back side.

Reducing the dicing speed of blade, using the thick blade, and changing the blade frequently are the normal method to solve the cracking problem before, though these method can improve the problem a little bit, they can not resolve cracking trouble thoroughly, and there are many defects, such as 1.the short life of blade, which has been used to cut only several slice of wafers after cracks occur on the wafer, this increase the cost. 2.the low dicing speed of the blade less than 30mm/s reduces the capacity. 3. Even now All products being optical inspected makes operators very busy, cracking phenomenon just likes time bomb which will explode at any moment, it will cause prodigious expense if not found in time, and commercial production is impossible.

In order to solve cracking problem thoroughly, we should find out the essential causation from cracking mechanism, then take corresponding measure to solve the problem.

By lots of simulating test, we have found that there is not any crack on the polished slice, known namely as slice of monocrystalline silicon, which without any pattern. Therefore, the passivation layer, testing pattern, metal film, and so on, are the main cause of cracking. Forwhy do cracks come into being due to the passivation layer, testing pattern and metal film within the dicing groove?

At first, we can explain from dicing mechanism. The dicing blade is made of grinding grain and bond, and the edge of blade takes the shape of sawtooth normally.

When the blade dicing at a high rotary speed, cut powder is taken out by the sawtooth, at the same time the grinding grain wear and come off continually to keep the edge sharp. As the existence of the passivation layer, testing pattern, metal film, an so on, such powder stays and overflows inside the sawtooth, the grinding grain comes off difficultly, and the edge becomes blunt, as called overload. Therefore, cracks occur on the thin wafer which suffers a great pressure.

Two effective methods are produced after experimentation, which can control cracking problem , aiming at the causation above-mentioned.

3.2.1 Choosing the blade with fine and nondense grain, styled as NBC-ZH104F 27HDDD(the normal type is NBC-ZH2050 27HEDD), at the rotary speed of 40000rpm, cutting speed of 60mm/s. In virtue of fine and nondense grain (compared with normal dicing blade), the edge keeps sharp for its grinding grain comes off easily. This blade can ensure better dicing effect, but can't solve the problem of cracking on back side thoroughly for there are still slight cracks on the edge of the chip back by such dicing technique.

3.2.2 Using new dicing method –dicing technique of grooving

Cracking is due to the disaccord between the surface and the underlay of the monocrystalline silicon on the chip. In order to solve this problem , we should try to

slice off the surface layer. Grooving dicing technique so-called is cutting a groove in certain depth and width to take off the surface layer before dicing normally. When cutting a groove dealing with the surface layer, we choose the blade with fine grinding grain, and increase its rotary speed. The parameters are below:

The first step: Grooving

Blade styled as NBC-ZH2030 27HCDF, rotary speed of 40000rpm, cutting speed of 80mm/s.

The second step: cutting off

Blade styled as NBC-ZH2050 27HEDD, rotary speed of 30000rpm, cutting speed of 80mm/s.

Production practice proves that cracks on both side of face and back can be avoided in this way above-mentioned.

In the early stage of production, the yield only reaches 85%. After improving on process the yield reaches 90%-98% which can not meet the needs of customers yet. But now, the yield can reach over 99.9% as a result of our researching and exploring for dicing technique.

Followings are statistics of cracking rate of the most serious chips in one lot every month before and after improvement, as shown in table1.—2. (Fig4.—5.).

Cracking Rate before Improvement

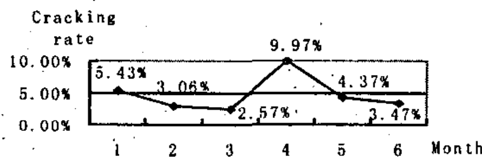

Fig4.

Month before improvement	January	February	March	April	May	June
Number of Chips	6900	17021	15451	6010	14051	16572
Number of face side cracking chips	375	520	397	599	614	575
Cracking rate	5.43%	3.06%	2.57%	9.97%	4.37%	3.47%

Table1

Cracking Rate after Improvement

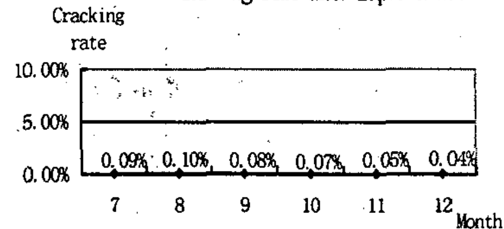

Fig5.

Month after improvement	July	August	September	October	November	December
Number of Chips	12821	15394	13942	19886	17785	18416
Number of face side cracking chips	12	15	11	14	9	8
Cracking rate	0.09%	0.10%	0.08%	0.07%	0.05%	0.04%

Table2

4. SUMMARY

We have solved the cracking problem radically by choosing new type of dicing blade and using grooving dicing technique after researching and testing on the dicing problem of wafer 6 inch in diameter and 200 μ m in thickness. The success not only liberates the operators from heavy inspecting work under microscope to increase the producing speed, but also increases the yield obviously. It makes commercial production possible and avoids the quality hidden trouble of IC Card.