Packaged and Wafer Level Semiconductor Failure Analysis
(SJK2-10)

Au Yueng, Lok Man
Chuang, Si Wing

Prof. Johnny Sin

Project Overview

Introduction

The semiconductor industry plays an important role in the economic growth of the world. Many companies work on the design and fabrication of semiconductor devices to fulfill the market needs. As the market needs change with time, it is necessary to reduce the launching time of the product to meet the market demand. Semiconductor failure analysis helps engineers to locate the failure and take corrective actions to improve and optimize their product design and performance.

Aim and Objective

- perform reverse engineering by obtaining the stitched image
- optimize the uniformity of the die
- increase the accuracy and efficiency of the stitching process.

System Block Diagram

Methodology of Hardware Part

Face lapping is a delaying process which allows the engineers to perform reverse engineering. The engineers can observe the circuits in different layers of the chip by a uniform surface.

The concept of obtaining a uniform surface is to place the dummy silicon near the corners of the specimen to block the slurry. Less slurry can reach the corners of the specimen so less chemical reaction takes place. Therefore, the etch rate of the specimen corners decreases and the uniformity of the specimen can be improved.

Methodology of Software Part

Most of the software in the market is developed for landscape picture stitching. Those pictures have a unique feature which can be easily noticed. However, there are a lot of repeated patterns in the IC layout, which make the recognition more difficult. Therefore, the software cannot generate a perfect stitching output for IC image.

Proposed Solution

There are three factors affected the uniformity of the specimen and they were the location of the specimen on the lapping cloth, the location of the dummy silicon on the holder and the size of the dummy silicon.

<table>
<thead>
<tr>
<th>Factors</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mounting tolerance of specimen</td>
<td>&lt;31um</td>
</tr>
<tr>
<td>Specimen</td>
<td></td>
</tr>
<tr>
<td>Location of the specimen on</td>
<td>Specimen is placed 11 cm away</td>
</tr>
<tr>
<td>lapping cloth</td>
<td>from the cloth center</td>
</tr>
<tr>
<td>Location of the dummy silicon on</td>
<td>Dummy silicon is placed 20 mm</td>
</tr>
<tr>
<td>the holder</td>
<td>away from the specimen center</td>
</tr>
<tr>
<td>Total size of the dummy silicon</td>
<td>34.743 mm²</td>
</tr>
</tbody>
</table>

| Table 1 – Uniformity factors     |

Result of Hardware Part

Based on the above proposed solutions, the resulted image is shown in Image 1. The uniformity of the specimen has reached 84%.

Method of Software Part

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Proposed Solution

Scale invariant feature transform (SIFT) is a variable which can be adjust to control the number of matching. This variable is namely distRatio. A matching is accepted only if its distance is less than distRatio times the distance to the second closest match. It returns the number of matches displayed. The input procedure is:

1. Input image to the computer and open the matlab.
2. Input the matlab command to transfer the jpeg to pgm format.
3. Save the image at pgm format.
4. Change the distRatio from 0.1 to 0.9 and increment by 0.05.
5. Input the matlab command to perform matching process.
6. Input the matlab command to check the keypoint.

Result of Software Part

Guidelines of photo taking:
- Image excludes the black boundary
- Image requires the same vertical and horizontal level
- Image takes at least 30% overlapping

Table 2 – NCP5371 20x

<table>
<thead>
<tr>
<th>disRatio</th>
<th>Accuracy</th>
<th>Overlapping</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.1</td>
<td>100%</td>
<td>30% overlap</td>
</tr>
<tr>
<td>0.2</td>
<td>100%</td>
<td>40% overlap</td>
</tr>
<tr>
<td>0.3</td>
<td>100%</td>
<td>50% overlap</td>
</tr>
<tr>
<td>0.4</td>
<td>100%</td>
<td>60% overlap</td>
</tr>
</tbody>
</table>

Table 3 – 555 timer 20x

The accuracy is too low to suggest a disRatio for 555 timer 10x.

Image 1 – Image of specimen

Image 2 – A part of NCP5371

Image 3 – 555 timer