Introduction

- NAND Flash: Some bad blocks.
- Bad Block
  - One or More invalid bits: Reliability is not guaranteed
  - One of the most important factors: Great influence to the quality
- Wafer Probe Test
  - Electrically checks: All individual chips on wafer
  - Bad blocks per each chip

✓ If we don’t the additional failure analysis, we don’t Know the failure type of bad blocks
Proposed Method

- Process of failure analysis
  - Monitor the distribution of bad blocks
  - Directly conduct failure analysis
  - Define specific failure types of bad blocks

- Too much time and effort
- Only a small number of bad blocks

Develop an automated bad blocks analysis system
- First, get information of all bad blocks per each chip
- Second, set to internal memory of test equipment
- Third, conduct multiple test items
- Finally, define failure types of bad blocks by the logic

- Can know specific failure type of bad blocks without additional failure analysis
- Can efficiently monitor changes of failure types without extra time and effort
Results

<table>
<thead>
<tr>
<th>Procedure of failure analysis</th>
<th>Chip</th>
<th>Bad blocks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Chip1</td>
<td>A</td>
</tr>
<tr>
<td>2</td>
<td>Chip1</td>
<td>B</td>
</tr>
<tr>
<td>3</td>
<td>Chip1</td>
<td>C</td>
</tr>
<tr>
<td>4</td>
<td>Chip2</td>
<td>D</td>
</tr>
<tr>
<td>5</td>
<td>Chip2</td>
<td>E</td>
</tr>
<tr>
<td>6</td>
<td>Chip3</td>
<td>F</td>
</tr>
<tr>
<td>7</td>
<td>Chip3</td>
<td>G</td>
</tr>
<tr>
<td>49</td>
<td>Chip10</td>
<td>AW</td>
</tr>
<tr>
<td>50</td>
<td>Chip10</td>
<td>AX</td>
</tr>
</tbody>
</table>

As Is

<table>
<thead>
<tr>
<th>Procedure of failure analysis</th>
<th>Chip</th>
<th>Bad blocks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>All</td>
<td>A,D,F, *** ,AW</td>
</tr>
<tr>
<td>2</td>
<td>All</td>
<td>B,E,G, *** ,AX</td>
</tr>
<tr>
<td>3</td>
<td>All</td>
<td>C</td>
</tr>
</tbody>
</table>

To Be

Parallel failure analysis
(Time: 0.6 hour)

Serial failure analysis
(Time: 9.8 hour)

✓ Significantly reduce time of failure analysis : 95%(9.8Hr → 0.6Hr)

✓ Compare distribution of failure type 1:
B-Line is higher than A-Line(some recipes)

Conclusion

- Requirements for quality about nand flash are recently growing
- Many companies study various methods to improve the quality
- So, we develop an automatic bad blocks analysis system
- System automatically analyze failure types of bad blocks in real time
- Can know specific failure type of bad blocks without additional failure analysis
- Can efficiently monitor changes of failure types without extra time and effort