Optimization Methodology of clean pads selection for lifetime and test yield on RF bump wafer test with membrane probe card

I-Pin Chia, Min-Chang Tu, Paul Yeh

WIN Semiconductors Corp, No. 35, Technology 7th Road, Hwaya Technology Park,
Kuei Shan Hsiang, Tao Yuan Shien, Taiwan 333

E-mail: schia@winfoundry.com
Phone: +886-3-3975999#1548

Abstract

Low-level and stable contact resistance is imperative for wafer testing yield. In general, the efficient way to control contact resistance is using on-line cleaning (probe polish) during wafer testing, but a strength clean pad will bring much abrasive and reduce probe card lifetime. Consequently, scheduled cleaning procedure has become very critical issue on wafer testing, especially on bump wafer.

Introduction

Why the methodology is needed? We know the DC wafer testing on pads for years, as time goes by, more and more RF wafer testing are demanded. In order to narrow the gap between wafer testing and final testing, bump pads process is necessary. So, special probe card and special clean pad for bump probing is the next step we want to research.

Experiment and Results

On this topic, we use 6 new membrane probe cards and 6 different type clean pads as Figure.1 and Figure.2 to provide a optimization methodology which is based on ”Probe Card Cleaning Media Survey” [1] to choose the most suitable clean pad we want to use on bump wafer testing. There are totally 2 Measurements (Accelerated Wear Test and SEM Inspection) and 3 Parameters (C_{debris}, Yield and Wear rate) in this methodology.

In Accelerated Wear Test, we need to touch the clean times target 15K during the wafer testing and on wafer touchdown will also reach to 450K. Through this test, we can get the tip length variation (Wear rate) by ASA, particle images (C_{debris}) by SEM inspection and also wafer yields (Yield). One of the most important thing in this experiment is to define parameter C_{debris} which can be broke down to 3 elements, particle size, frequency and location. Once giving them each different weight, we can get the formula as below:

$$\mathbf{C_{debris} = 0.7(R_{particle}) + 0.2(F_{tip}) + 0.1(F_{memb})}$$

$R_{particle}$ means the particle size, F_{tip} means how often the particle will appear to the tip and F_{memb} means how many times the particle will appear to the membrane. Figure.4 shows the Ranking mechanism to above 3 elements.

Due to reduce the risk in this experiment, we separated it to 4 steps for each one new membrane probe card as Figure.3. End of each step always do the ASA & SEM measurement and average all the final data we get. After the experiment is finished, we can draw a chart to show the clean pads performance.

Figure.5 is the final results and chart of P1 to P6 clean pads experiments. The results are positive correlation to the real data which is provided by itself vendor. P1 & P2 are lapping film type which has 1.84~2.28um wear on the probe tips and 1.98~2.76 C_{debris} value. P3 & P4 are filled elastomers type which has the 0.27um wear, and 3.53~7.23 C_{debris} value. P5 & P6 are abrasive coated foams type which has 0.61~0.96um wear and 4.68~5.51 C_{debris} value.

Based on the sequence we have as Figure.5, we filter P1 & P2 & P5 & P6 first, then filter P5 & P6 second and P6 is the only one clean pads to meet our needs. In order to verify this conclusion, we put clean pad P6 in production line and test 4 bump wafers with RF test item, the clean pad P6 still has the best wafer yield and also match our results. Figure.6 is the wafer map and Figure.7 & 8 is the histogram chart of RF test item.

Conclusion

Though this methodology we can use less cost and get more efficiency to find out the suitable clean pads P6 for bump wafer testing. P3 & P4 is acting in silicone resin layer, the abrasive ability is weakness and also cause the lower wafer yield. P1 & P2 also can get good C_{debris} value, but the wear is large that will cause too much cost.

In the future, any new clean pads would be follow this methodology to do the performance checking and record in database. Next time we can quickly choose the clean pad we want to use.

Reference

[1] Eric Hill and Josh Smith, IEEE SWTW ”Probe Card Cleaning Media Survey” June 10,2008

[2] Rainer Gaggl and Dominique Langlois IEEE SWTW “Advanced in offline Resharping and Cleaning for Cantilever, Vertical and Lithographic Probe Cards, June 7-10, 2009

[3] Jerry Broz and Gene Humphrey and Wayne Fitzgerald, IEEE SWTW “Probe Card Cleaning – A Short Tutorial” June 3-6, 2007

Clean Paper	Vendor	Type	Grit size	Model
P1	ITS	Probe Lap	1um	Lapping Films
P2	ITS	Probe Lap	3um	Lapping Films
P3	ITS	Probe Polish 70	3um	Filled Elastomers
P4	ITS	Probe Polish 300	3um	Filled Elastomers
P5	MIPOX	WA4000	3um	Abrasive Coated Foams
P6	MIPOX	WA6000	2um	Abrasive Coated Foams

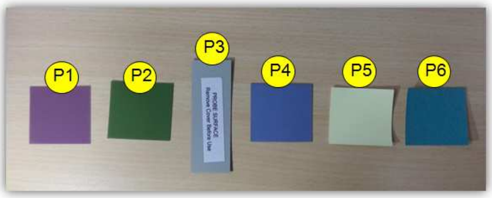

Fig.1 6 different type clean pads

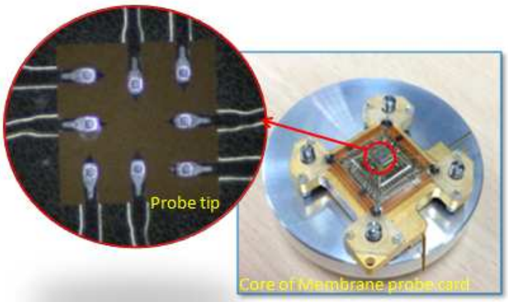

Fig.2 Probe tip and membrane probe card core

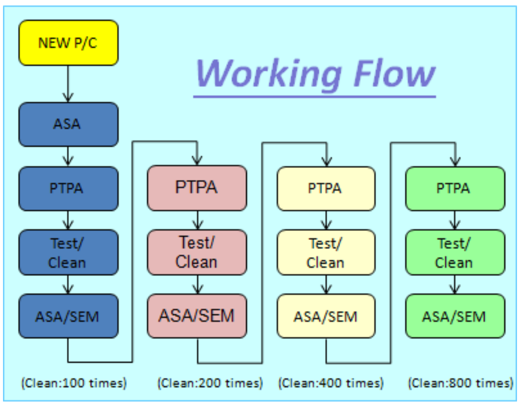

Fig.3 Working flow of the full experiment

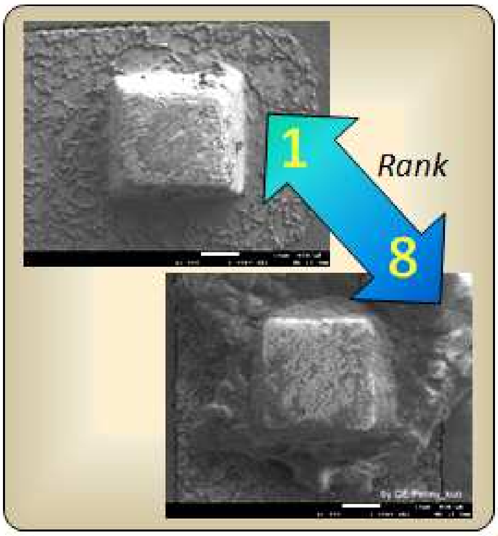

Fig.4 Ranking and Numeralization for the particle on the probe tip.

Membrane	Cdebris	Yield	Wear	Wear-Nor.
P1	1.9875	99%	1.8438	0.0369
P2	2.7625	99%	2.2838	0.0457
P3	3.5375	86%	0.0000	0.0000
P4	7.2375	77%	0.2725	0.0055
P5	5.5125	99%	0.6113	0.0122
P6	4.6875	99%	0.9650	0.0193

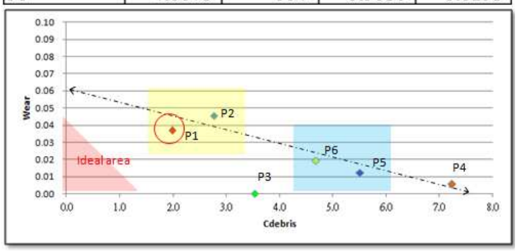

Fig.5 Experiment results and chart (Wear-Nor. means the data with normalize)

Fig.5 Judgment sequence and rule

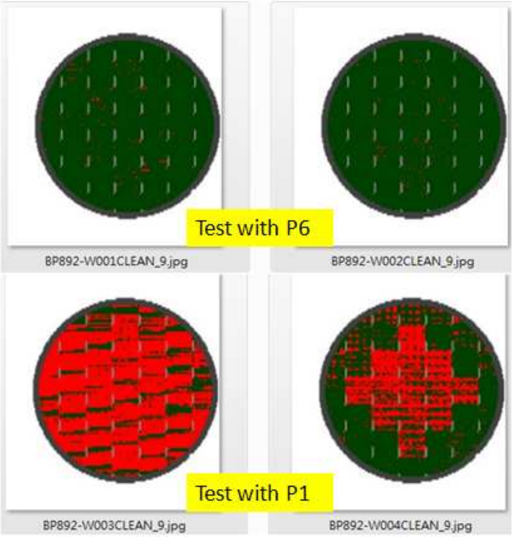

Fig.6 wafer map

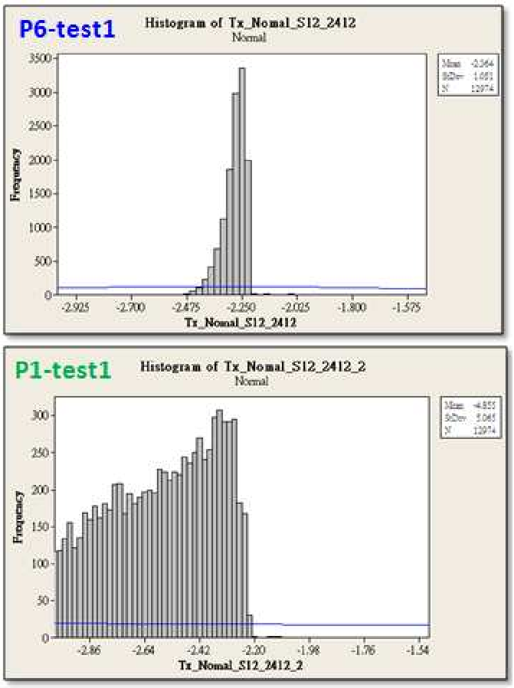

Fig.7 Histogram chart for first P1 & P6 whole wafer testing

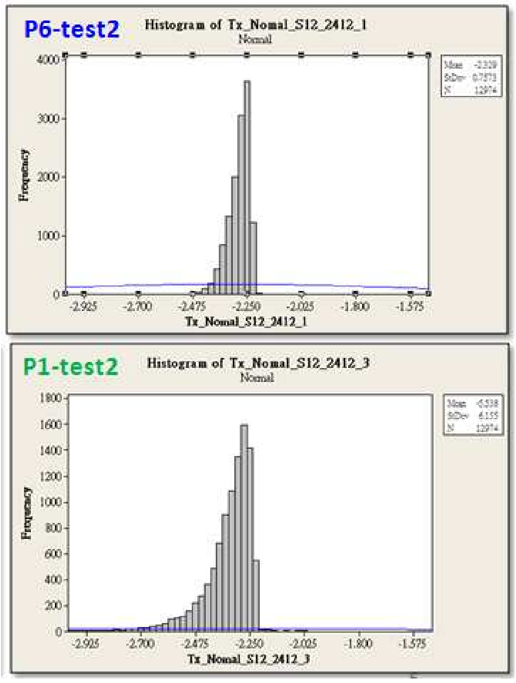

Fig.8 Histogram chart for second P1 & P6 whole wafer testing