



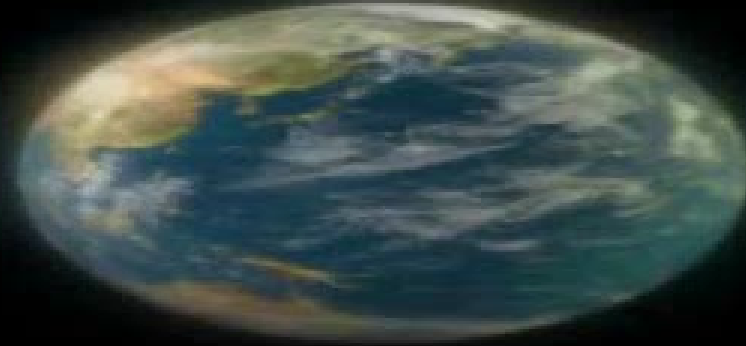
Semiconductor Pad Crater solved cases

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0. Company Overview



0. Company Overview

Pick the latest and greatest of Hynix memory products - 44nm 2Gb DDR3L

COMPUTING MEMORY

NAND FLASH
Save your memories with Hynix - 32nm 32Gb MLC

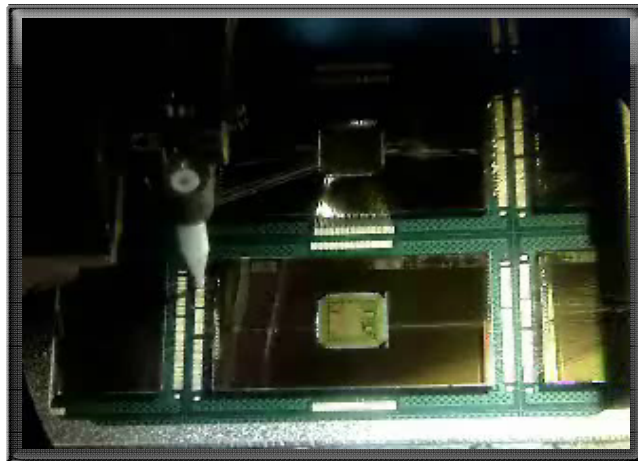


GRAPHICS MEMORY
Experience the joy of rich entertainment with Hynix Graphics memory products - 44nm 2Gb GDDR5

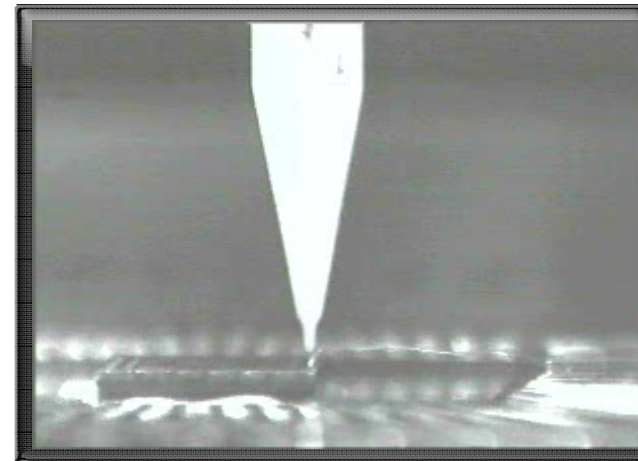
CIS (CMOS IMAGE SENSOR)
Ultra slim, low power, low-cost, progressive scan CMOS Image Sensor
2M 1/5"

1. Package process

No.	4-1	4-2	4-3	4-4	4-5	4-6	4-7
Symbol							
Process	Wafer Input	Sawing	Die Attach	Wire bond	Mold	Single	Shipped
Photo							



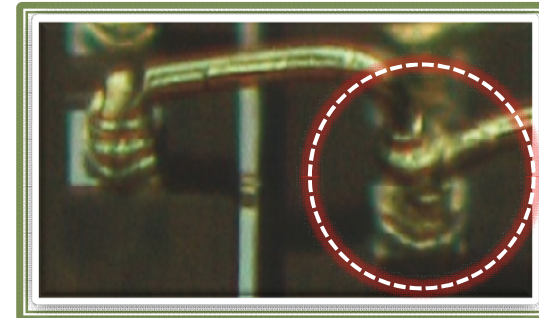
Wire Bond Process



High-speed camera

2. Define Problem

2.1. Problem situation

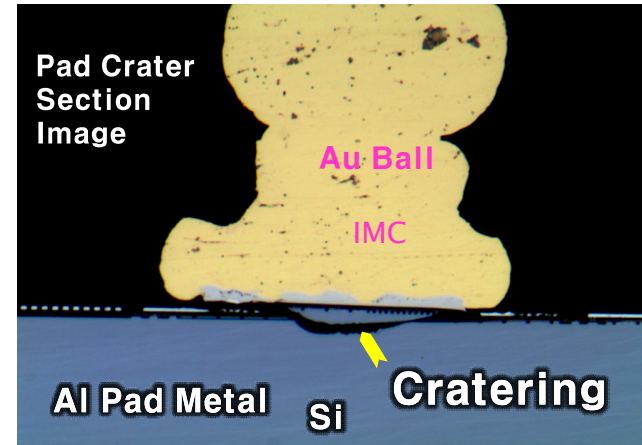


<p>Capillary →</p>	Miss Wire <p>Diagram illustrating a wire being lifted from a chip. A red dashed circle highlights the wire, and a red arrow points to the chip. The wire is shown as a jagged line, indicating a miss wire.</p>	<p>Microscopic photograph showing a chip with a miss wire. A red dashed circle highlights the wire, and a red arrow points to the chip.</p>
	Ball Lift (Pad Crater) <p>Diagram illustrating a wire being lifted from a chip. A red dashed circle highlights the wire, and a red arrow points to the chip. The wire is shown as a jagged line, indicating a ball lift.</p>	<p>Microscopic photograph showing a chip with a ball lift. A red dashed circle highlights the ball lift, and a red arrow points to the chip.</p>

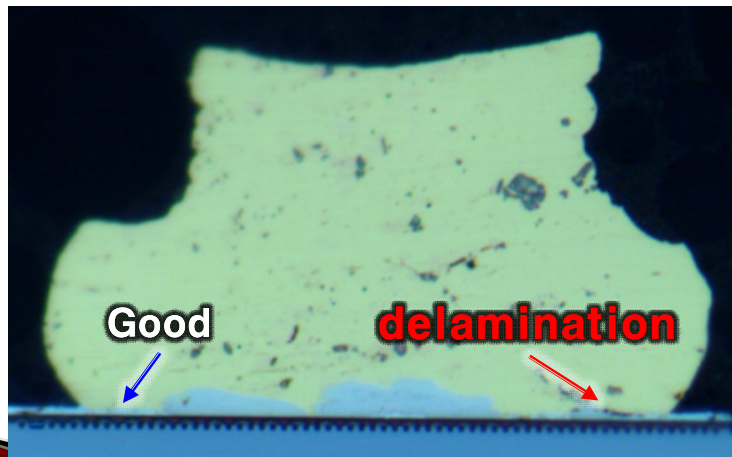
2. Define Problem

2.1. Problem situation (Pad Crater)

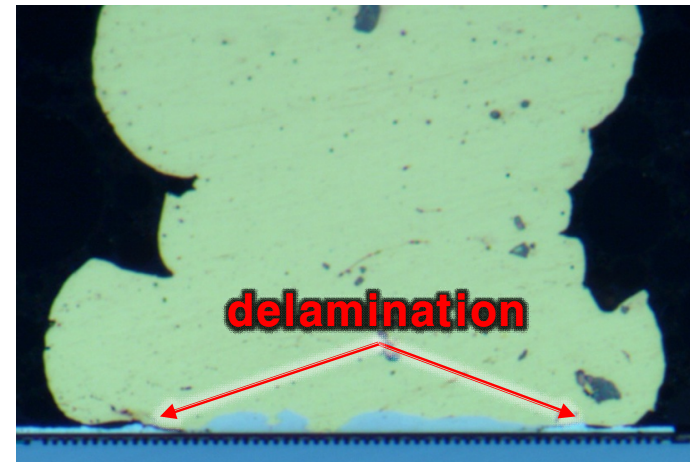
1st bonding



2nd bonding

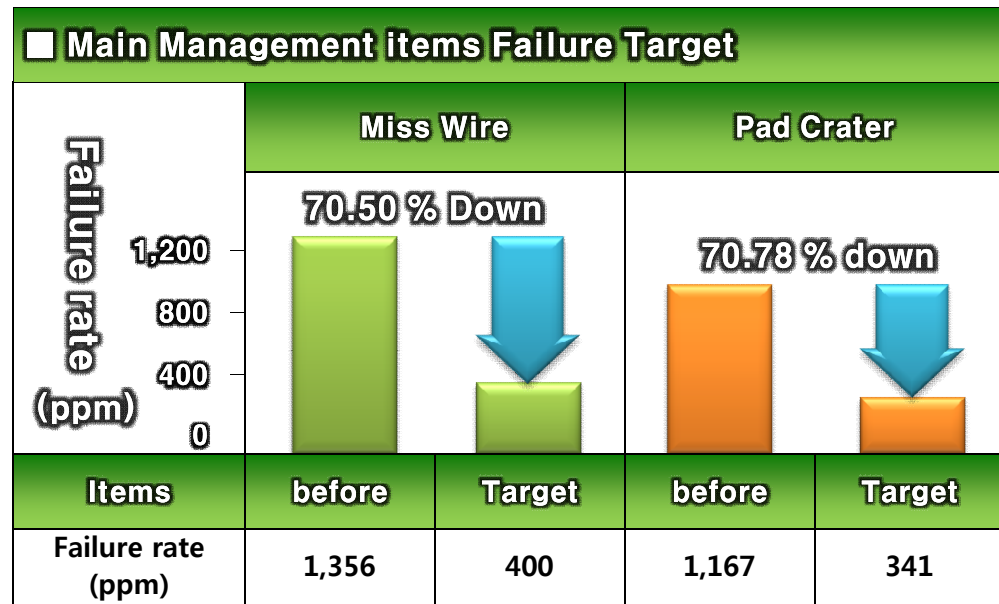
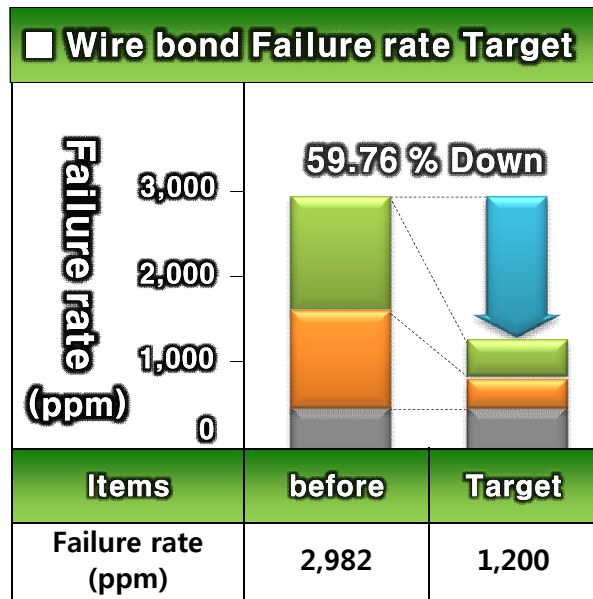


3rd bonding



2. Define Problem

2.2. Define performance indicator



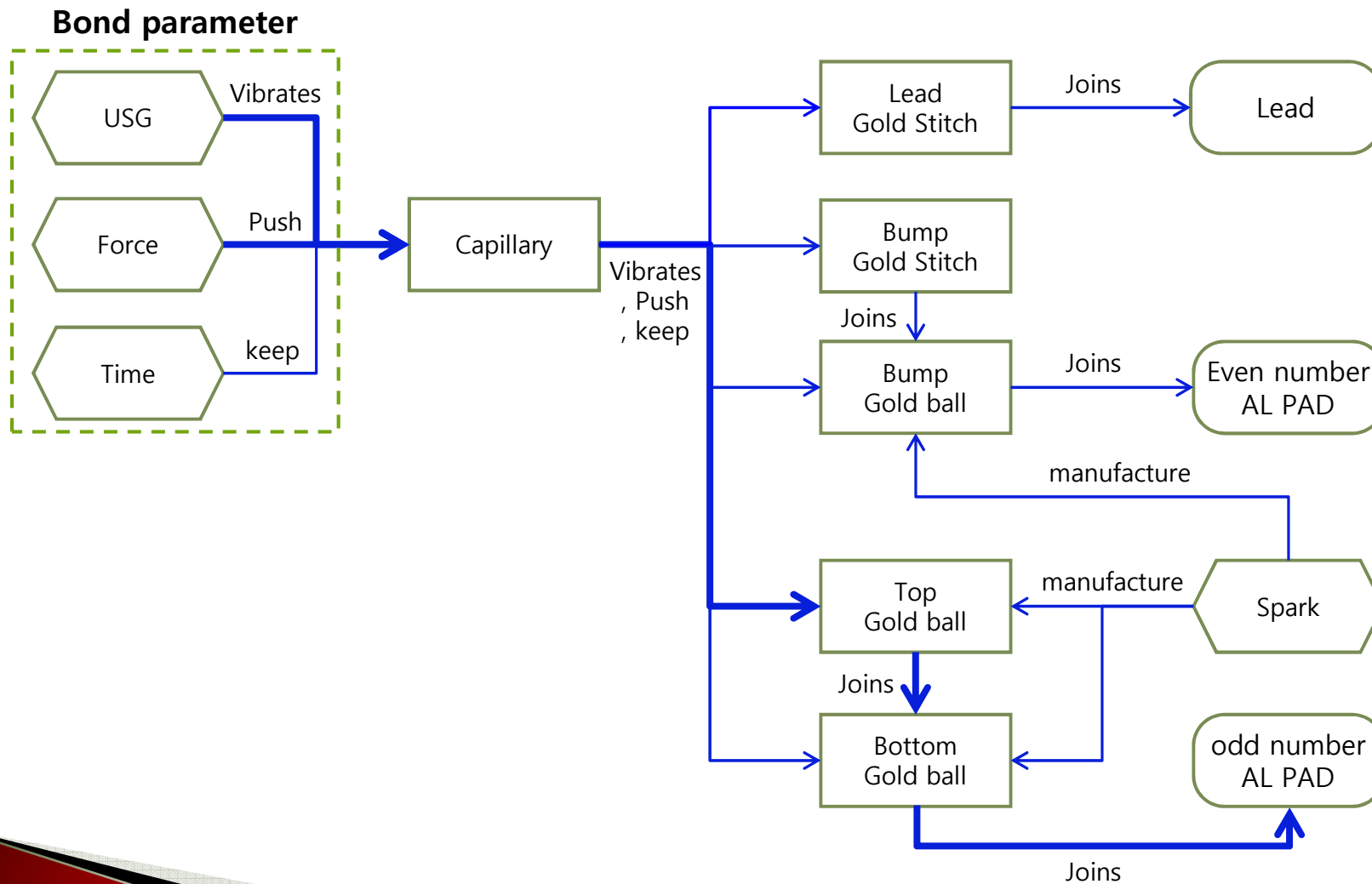
3. Problem Analysis

3.1. Resource Analysis & Multi screen

	D/A	Plasma	Wire Bond	Mold
Super system	Power, Force, Time , Temp, Warpage	Temp, Warpage , Ar Gas, Vacuum	USG Power, Force Time, Overhang Para Temp, Warpage	Temp, Warpage , Force, Compound
System	D/A System	Plasma System	Wire Bond System	Mold System
Sub system	odd number Al PAD , Even number Al PAD , Pad Roughness Die position	odd number Al PAD , Even number Al PAD , Pad Roughness Die position	Capillary, Die position, Lead Lead gold Stitch, Bump gold Stitch, , Bump gold ball, Spark , Bottom gold bal, Top gold bal , Pad roughness odd number Al PAD , Even number Al PAD	Mold Die ...

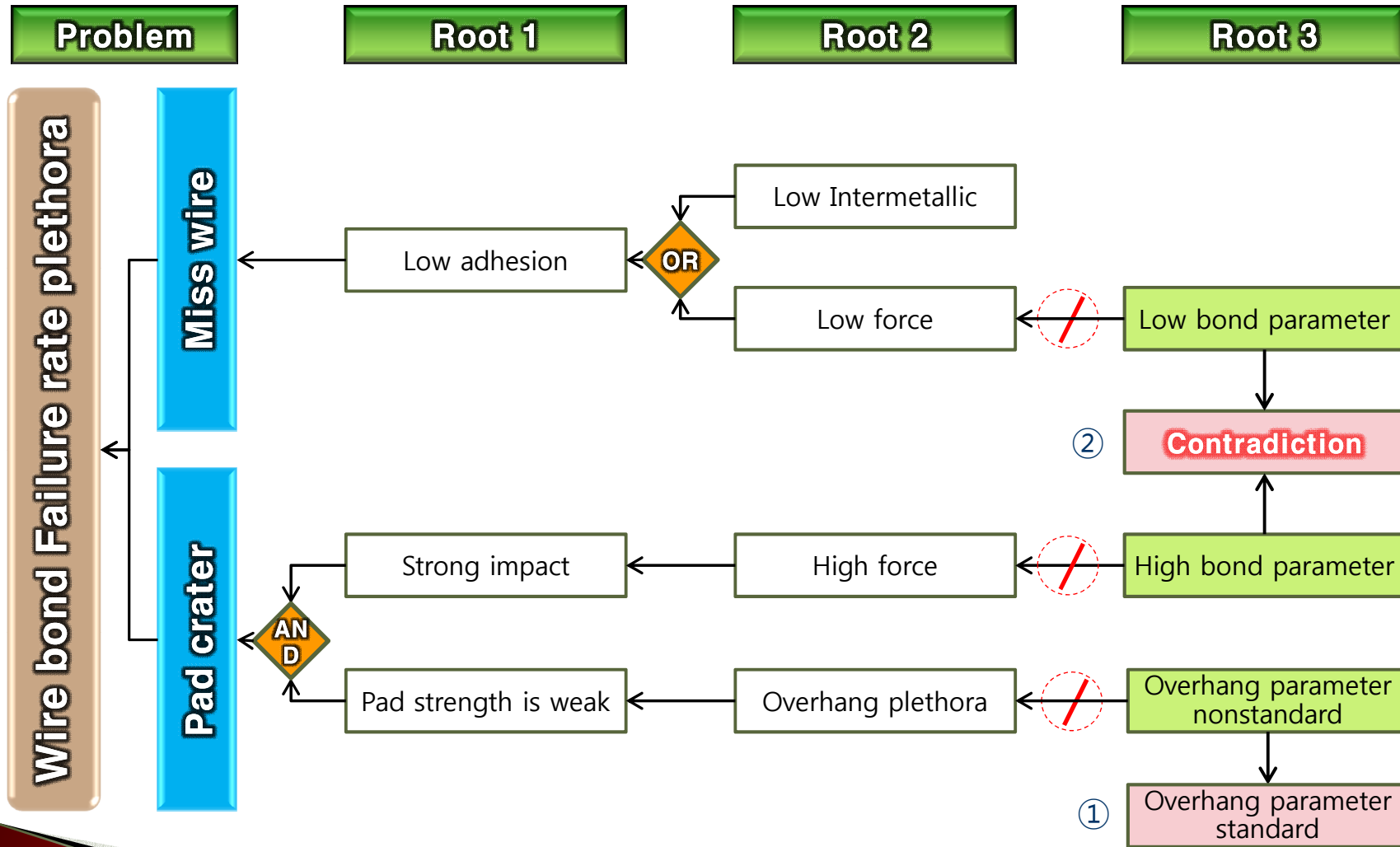
3. Problem Analysis

3.2. Function Analysis (Pad Crater)



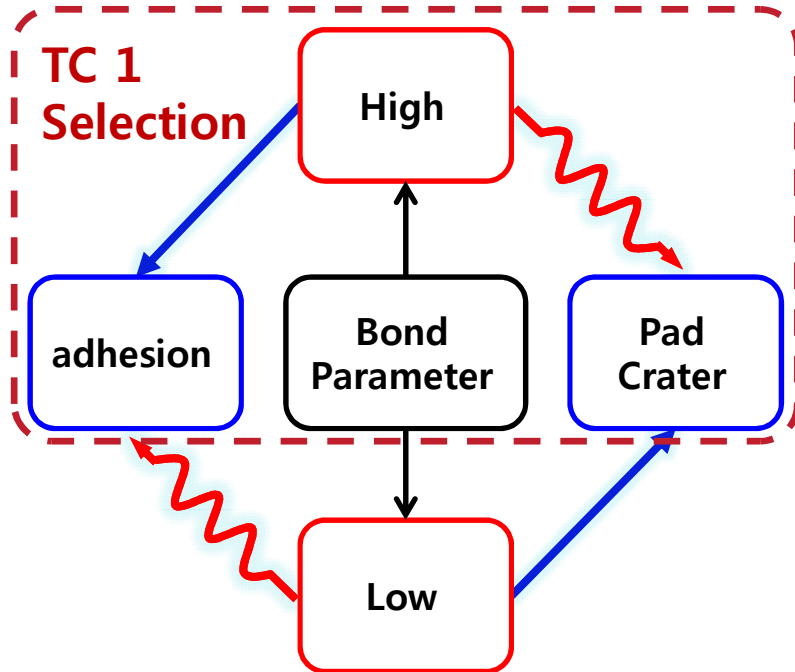
3. Problem Analysis

3.3. Root Cause Analysis



3. Problem Analysis

3.4. Contradiction modeling & Selection



TC 1

If bond parameter is high, Although have the strong adhesion, but Pad crater is occurred.

TC 2

If bond parameter bond is low, Although the Pad crater is not occurred but have weak adhesion.

PC

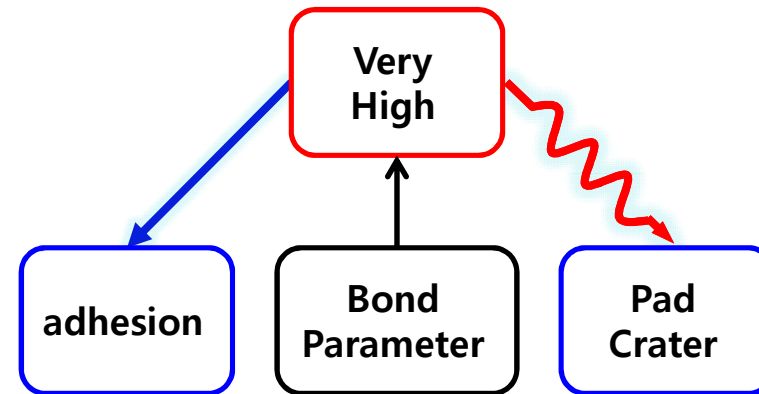
Bond Parameter is high and low.

3. Problem Analysis

3.5. Deepening Contradictions & Define X-elements

Deepening contradictions

A very high bond parameters ?



Define X-elements

Having the very high adhesion bond parameter and X-elements make strong adhesion and remove the pad crater

3. Problem Analysis

3.6. Define Ideal Final Result

<p>OZ</p>								
<p>OT</p>	<p>T2-1</p>				<p>T1</p>	<p>T2-2</p>		
	Plasma	Odd number Chip Bottom Ball bonding	Loop	Lead Stitch	Odd number Chip Top Ball Bonding	Even number Chip Ball bonding	Loop	Ball Stitch
<p>IFR</p>	<p>Without complex system, and additional adverse effects at the same time, during T1 or T2, at the odd number Chip Al pad (OZ), X-element make strong adhesion and remove the pad crater.</p>							

4. Idea Generation

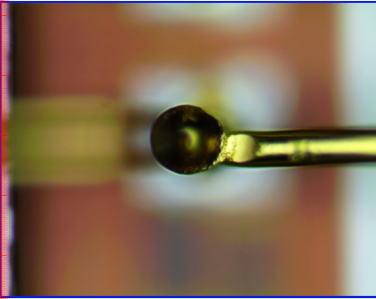
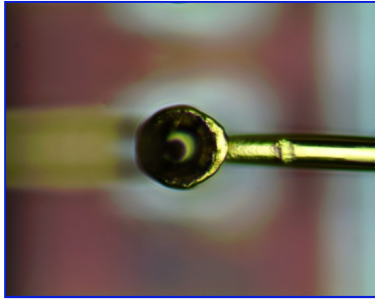
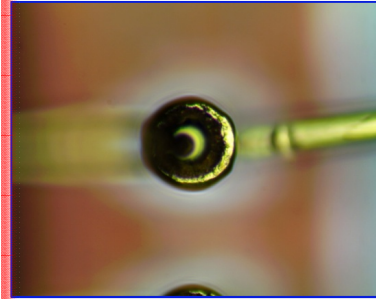


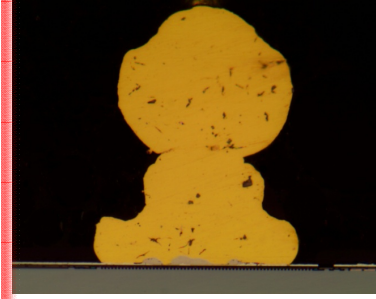
4.1. Validation X-elements

X-elements	No	Resource	Field	Idea	Negative Feedback	
	1	AL Pad Roughness	Chemical	Roughness changes by changing the plasma conditions	-	NG
	2	Die position	Mechanical	Overhang reduced by changing the chip location	D/A margin check W/B Loop touch check	NG
	3	Capillary design	Mechanical	Capillary contacts wide design review	-	NG
	4	Top Gold Ball Size	Mechanical	Big size Top Gold Ball and small size bottom Gold Ball	-	OK
	5	Top Gold Ball position	Mechanical	Top Gold Ball bonding change location => Side => Center	-	NG
	6	Overhang Para	Electric	Overhang Parameter Standardization	-	OK
	7	Vibration	Electric - Magnetic	Transducer "Y" Vibration => Bond head table "X"-"Y" Vibration change	Machine load increases	NG

4. Idea Generation

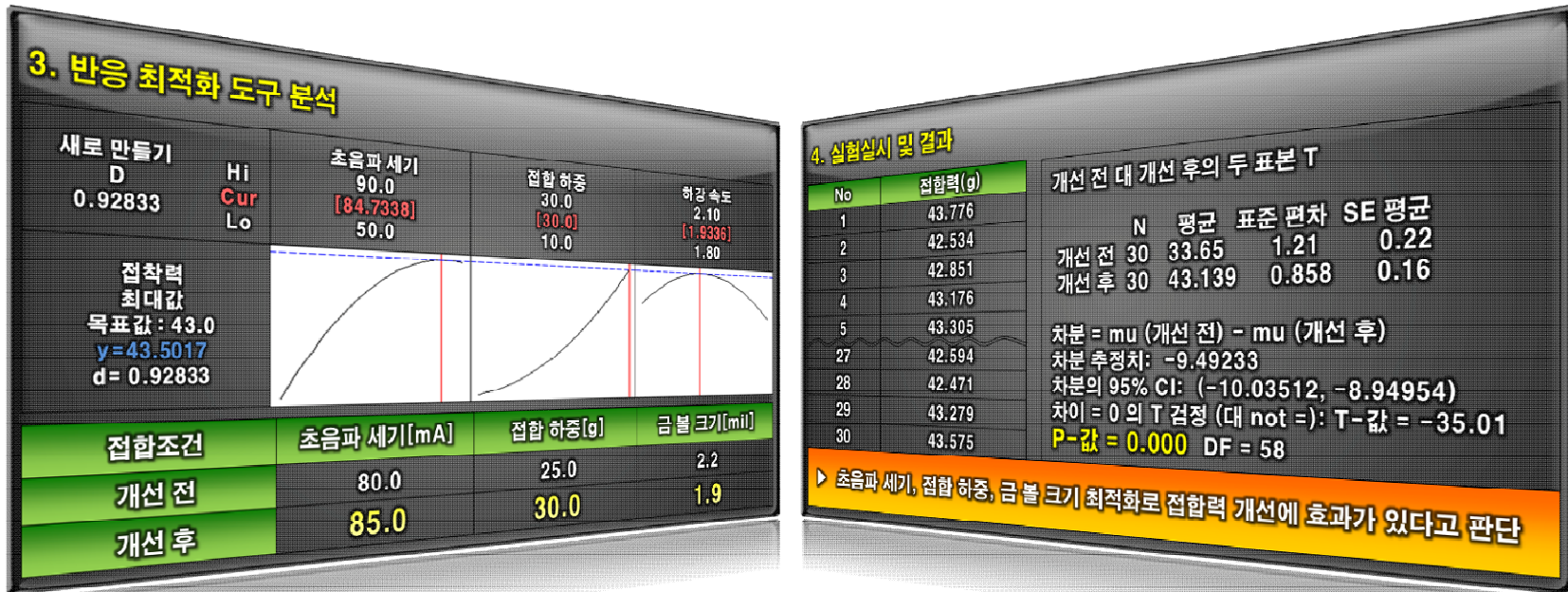
4.1. Validation X-elements (Top Gold Ball Size)

Separation Principle	Idea		
Separation in Time	Big size Top Gold Ball and small size bottom Gold Ball		

Gold Ball Size	1.8mil	2.1mil	2.4mil
Joining Image			
Section Image			
Judgment	OK	OK	NG

5. Apply ideas

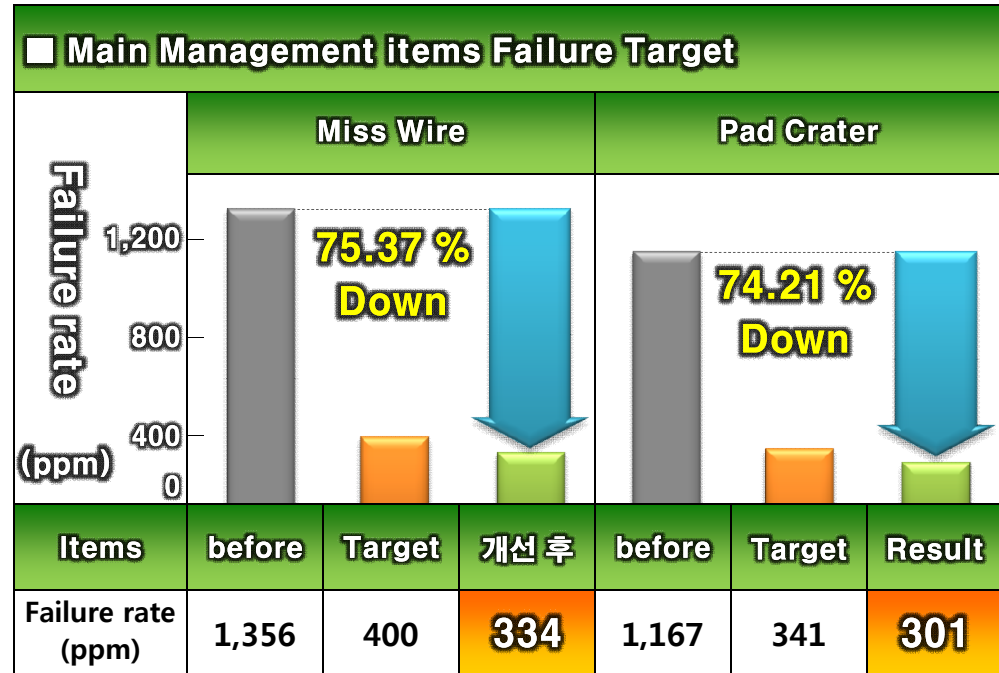
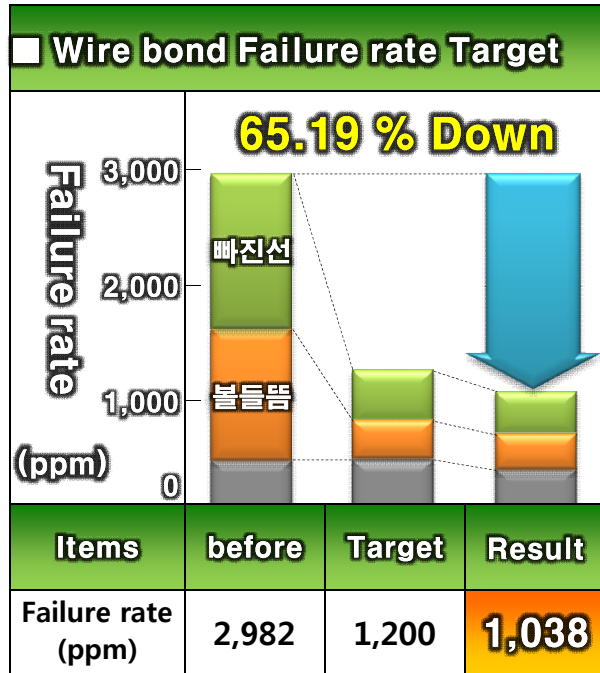
5.1. Design of Experiments



Optimization performed

6. Results

6.1. performance indicator



65.19 % Down



Thank you.