Semiconductor Pad Crater solved cases

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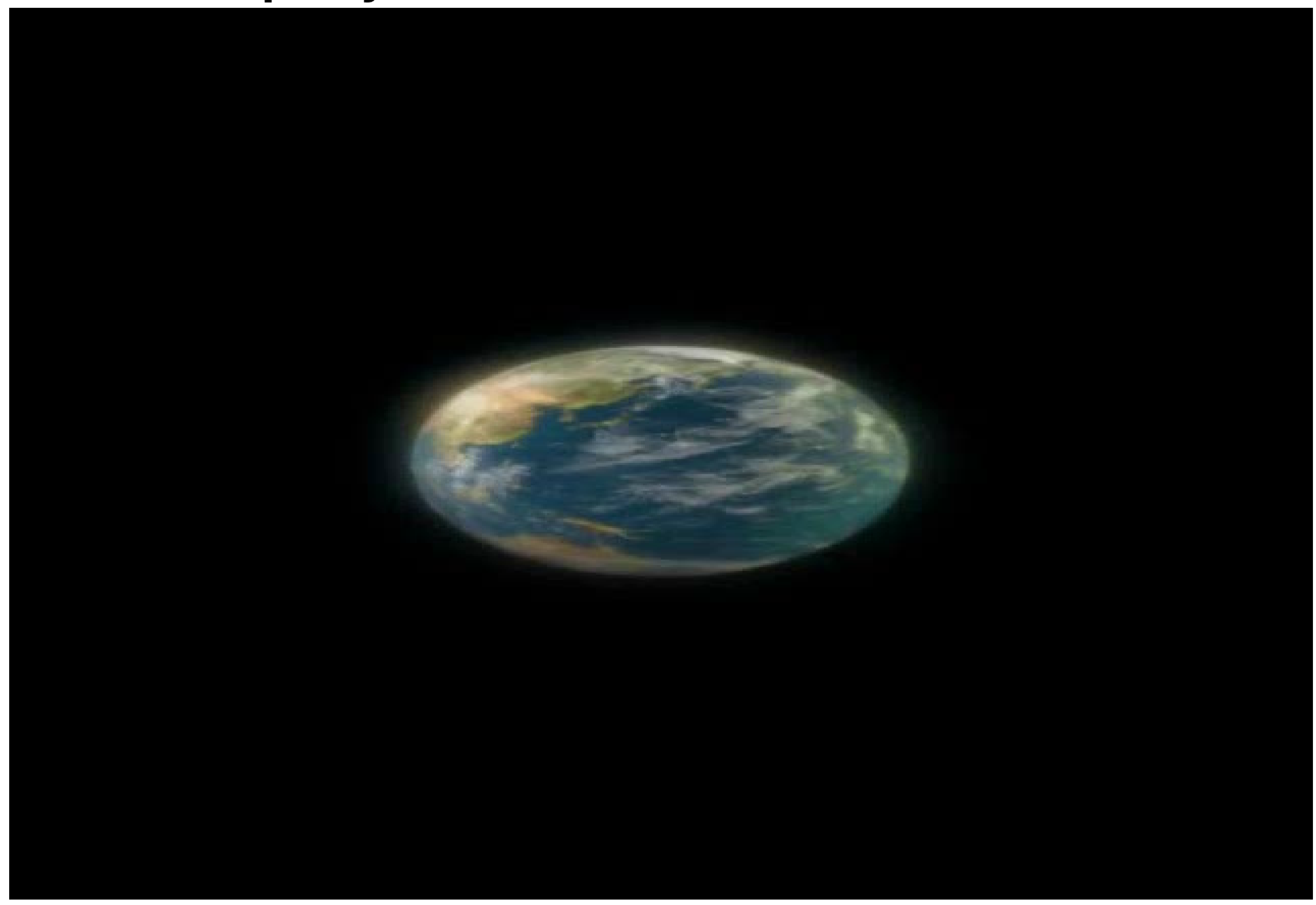
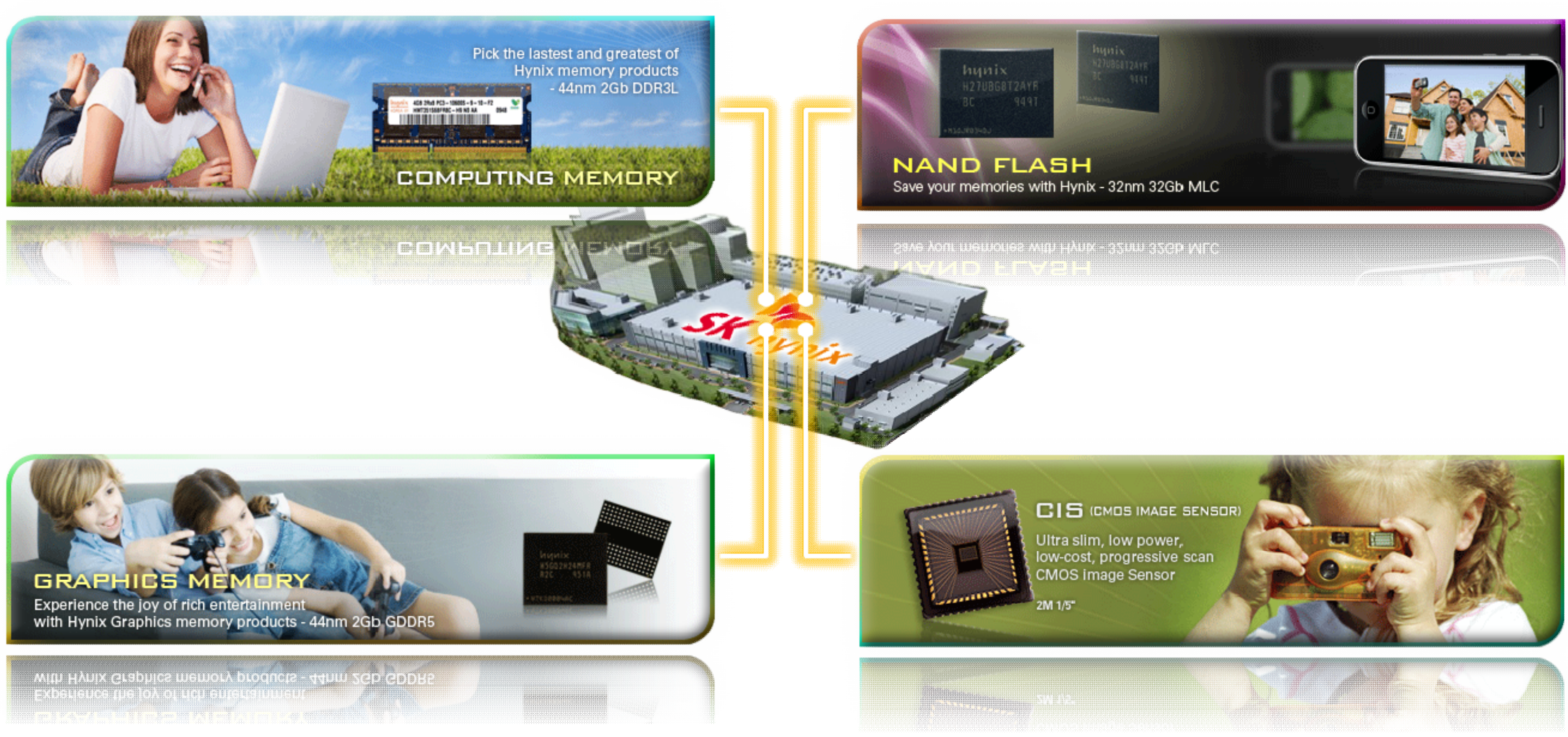
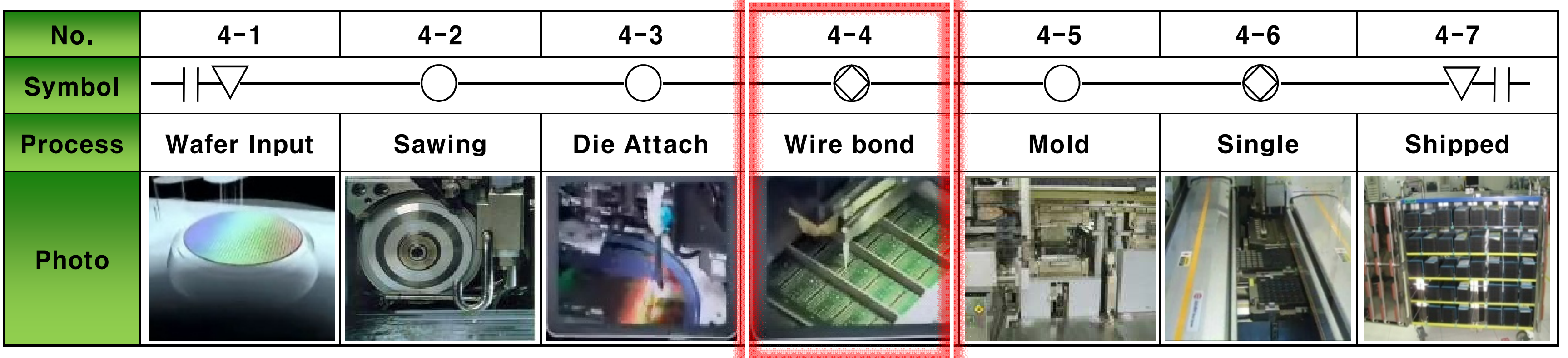
0. Company Overview



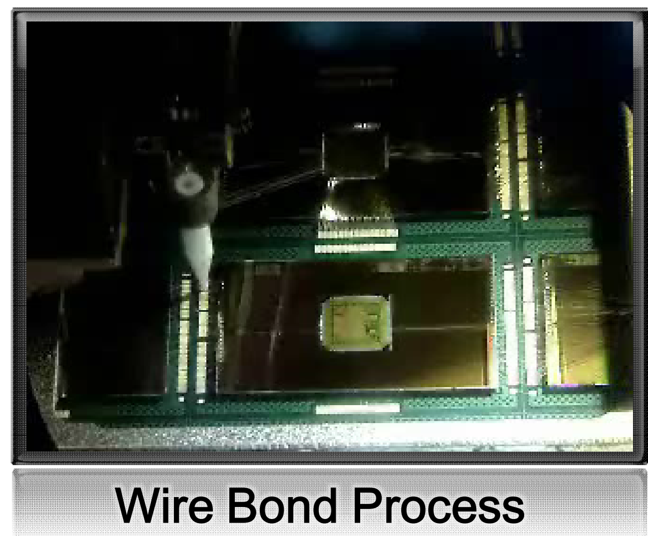
0. Company Overview



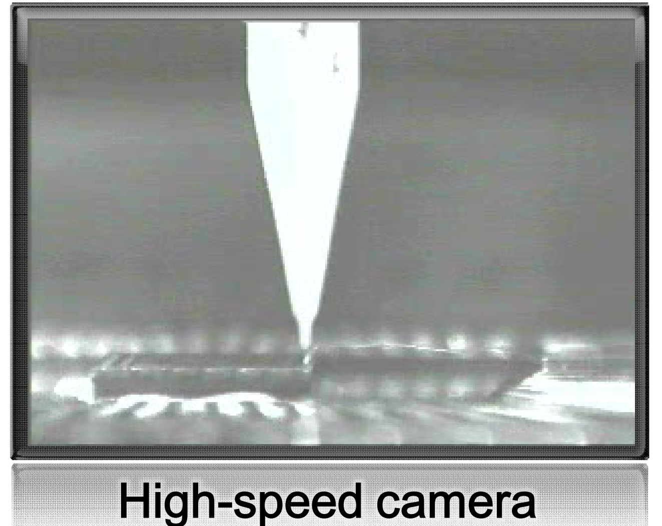
1. Package process



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							



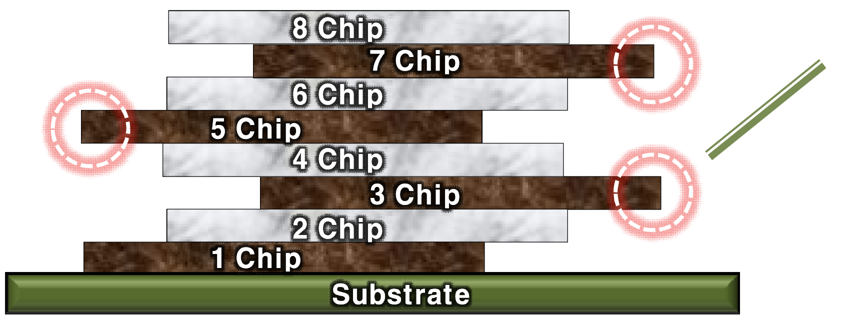
Wire Bond Process

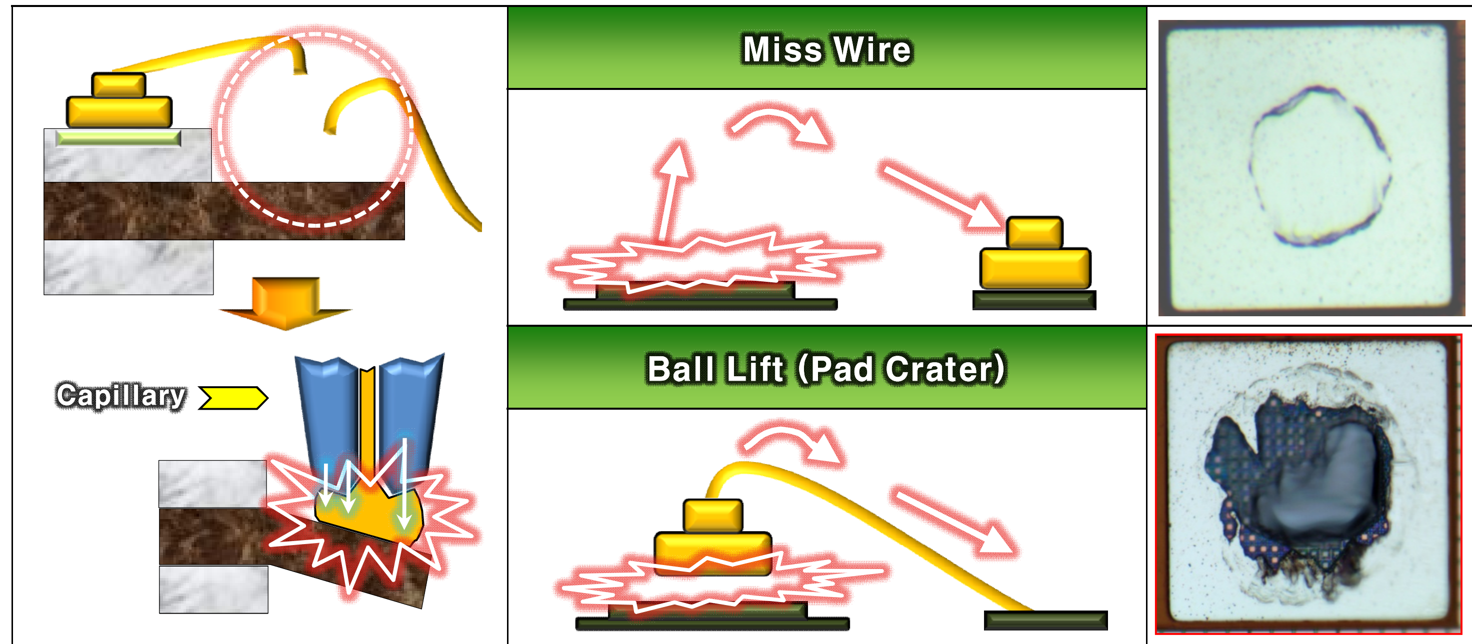


High-speed camera

2. Define Problem

2.1. Problem situation

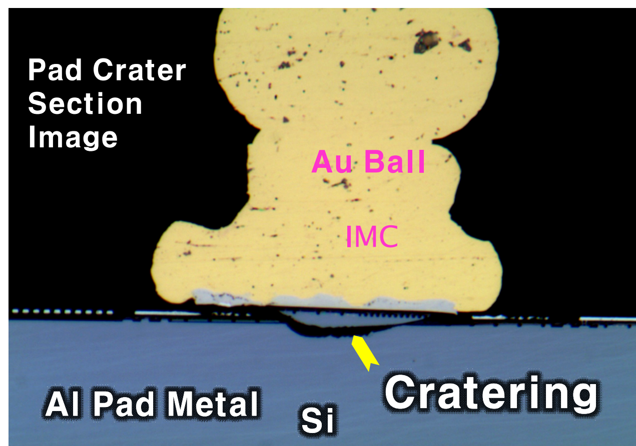




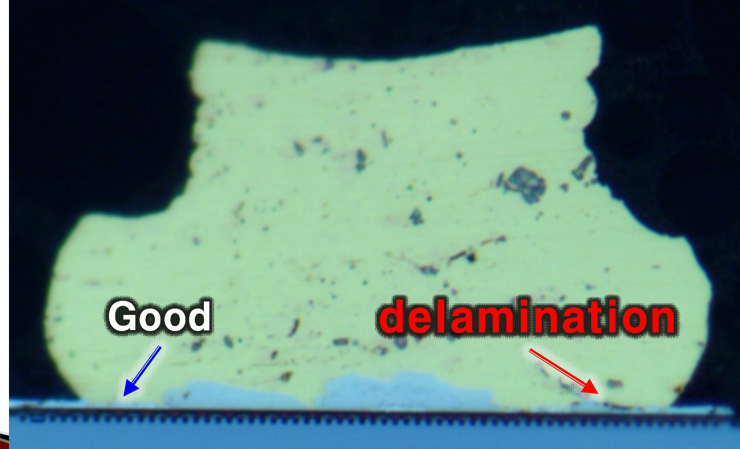
2. Define Problem

2.1. Problem situation (Pad Crater)

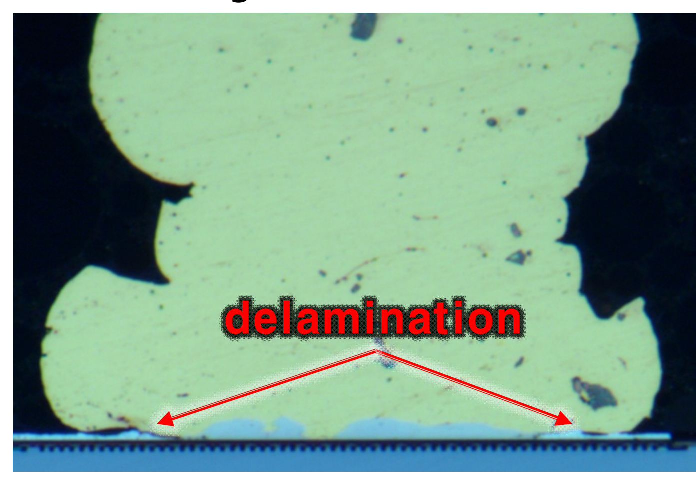
1st bonding



2nd bonding

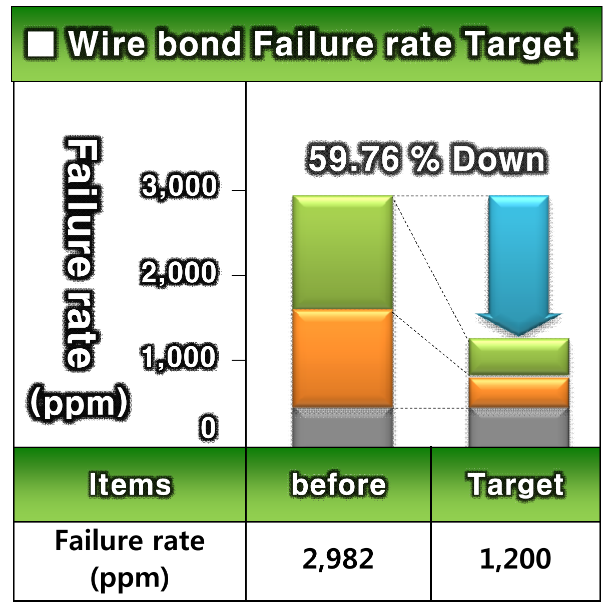


3rd bonding

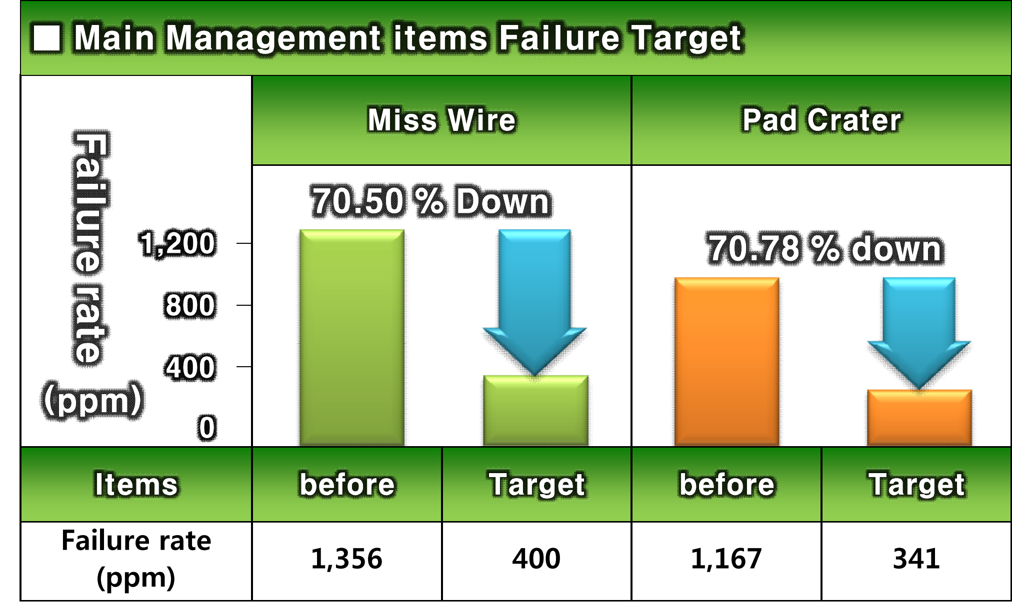


2. Define Problem

2.2. Define performance indicator



Items	before	Target
Failure rate (ppm)	2,982	1,200



Items	Miss Wire		Pad Crater	
	before	Target	before	Target
Failure rate (ppm)	1,356	400	1,167	341

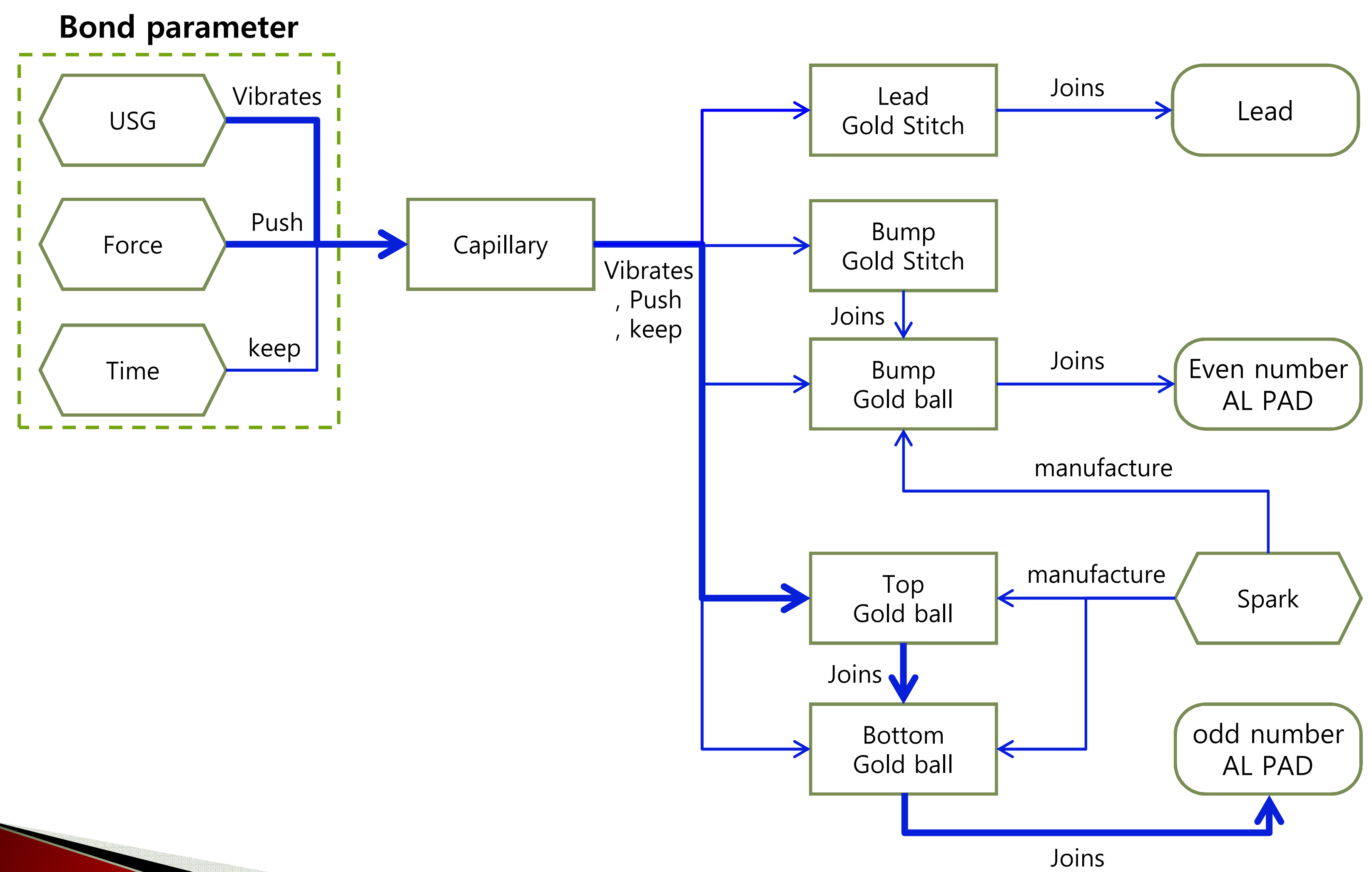
3. Problem Analysis

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 …

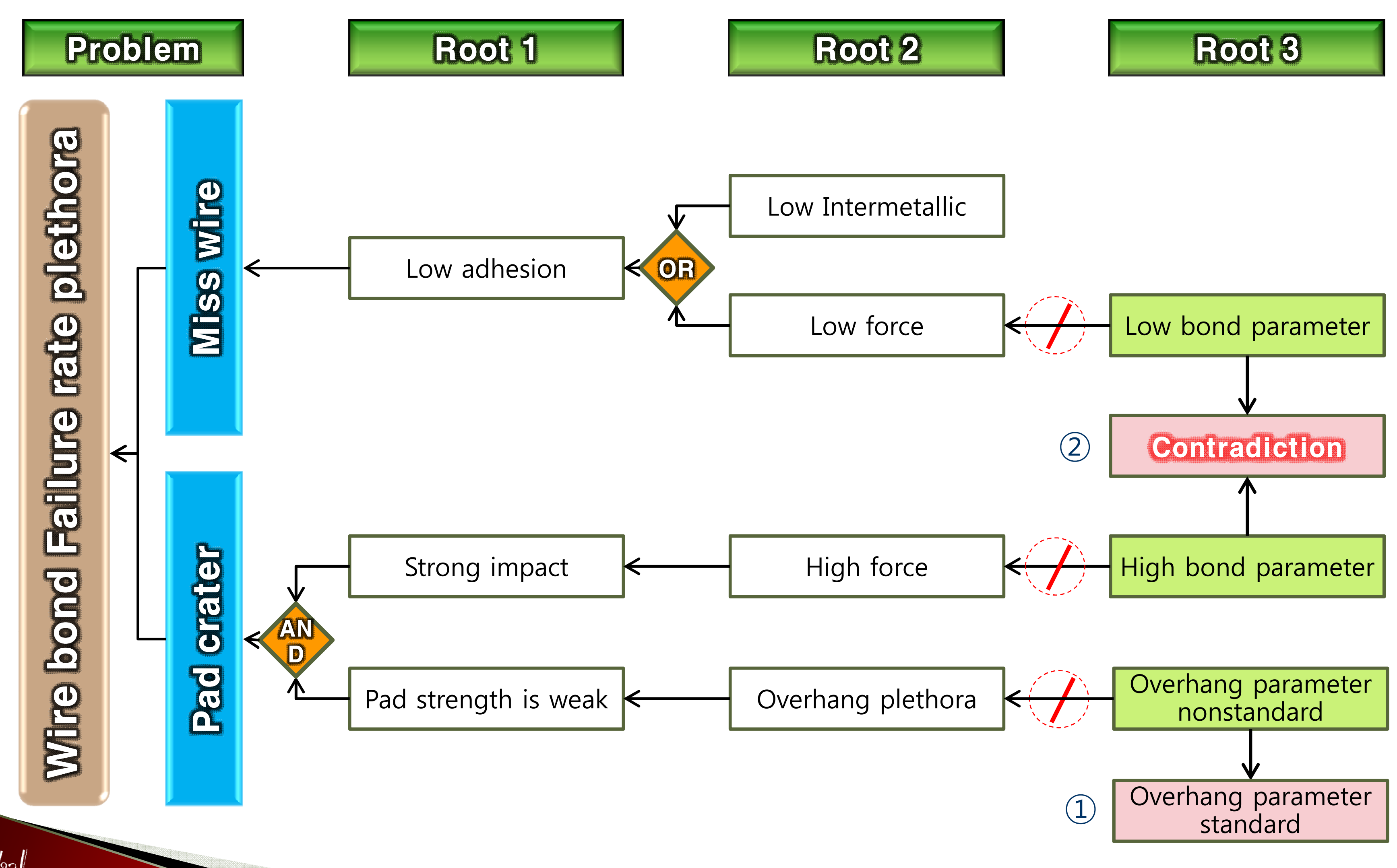
3. Problem Analysis

3.2. Function Analysis (Pad Crater)



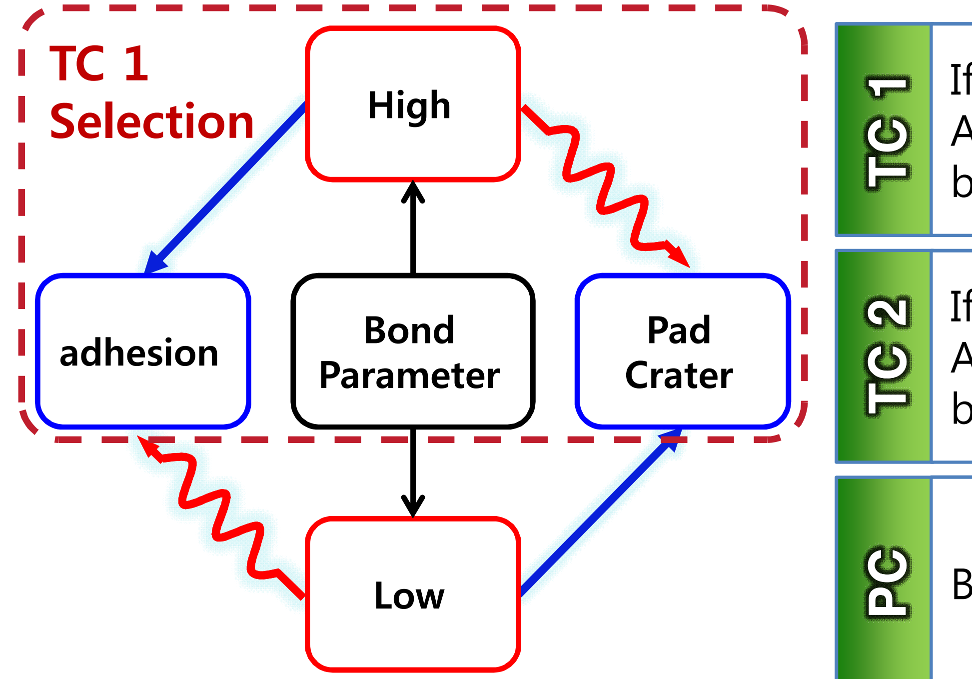
3. Problem Analysis

3.3. Root Cause Analysis



3. Problem Analysis

3.4. Contradiction modeling & Selection



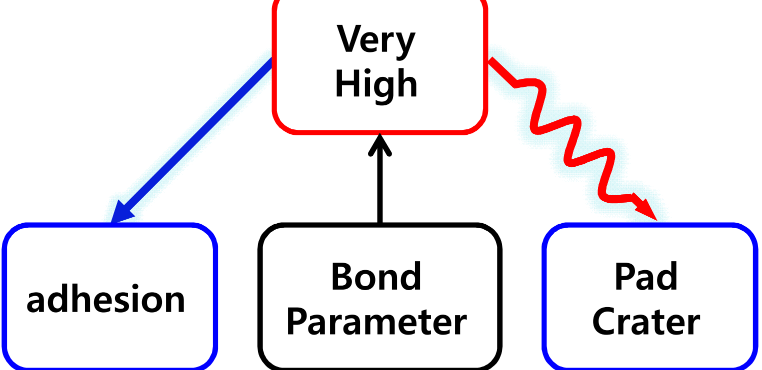
TC 1	If bond parameter is high, Although have the strong adhesion, but Pad crater is occurred.
TC 2	If bond parameter bond is low, Although the Pad crater is not occurred but have weak adhesion.
PC	Bond Parameter is high and low.

3. Problem Analysis

3.5. Deepening Contradictions & Define X-elements

Deepening contradictions

A very high bond parameters ?

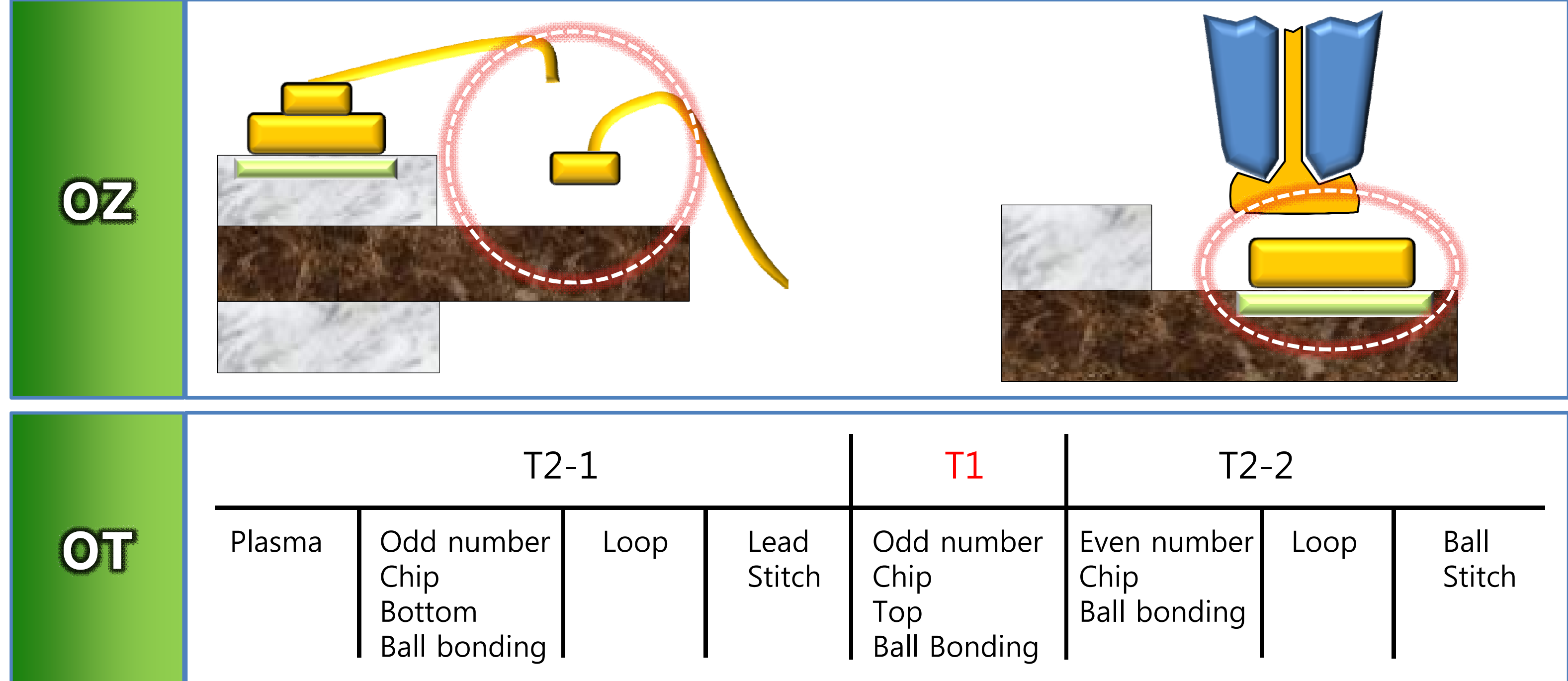


Define X-elements

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



IFR

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.

4. Idea Generation

4.1. Validation X-elements

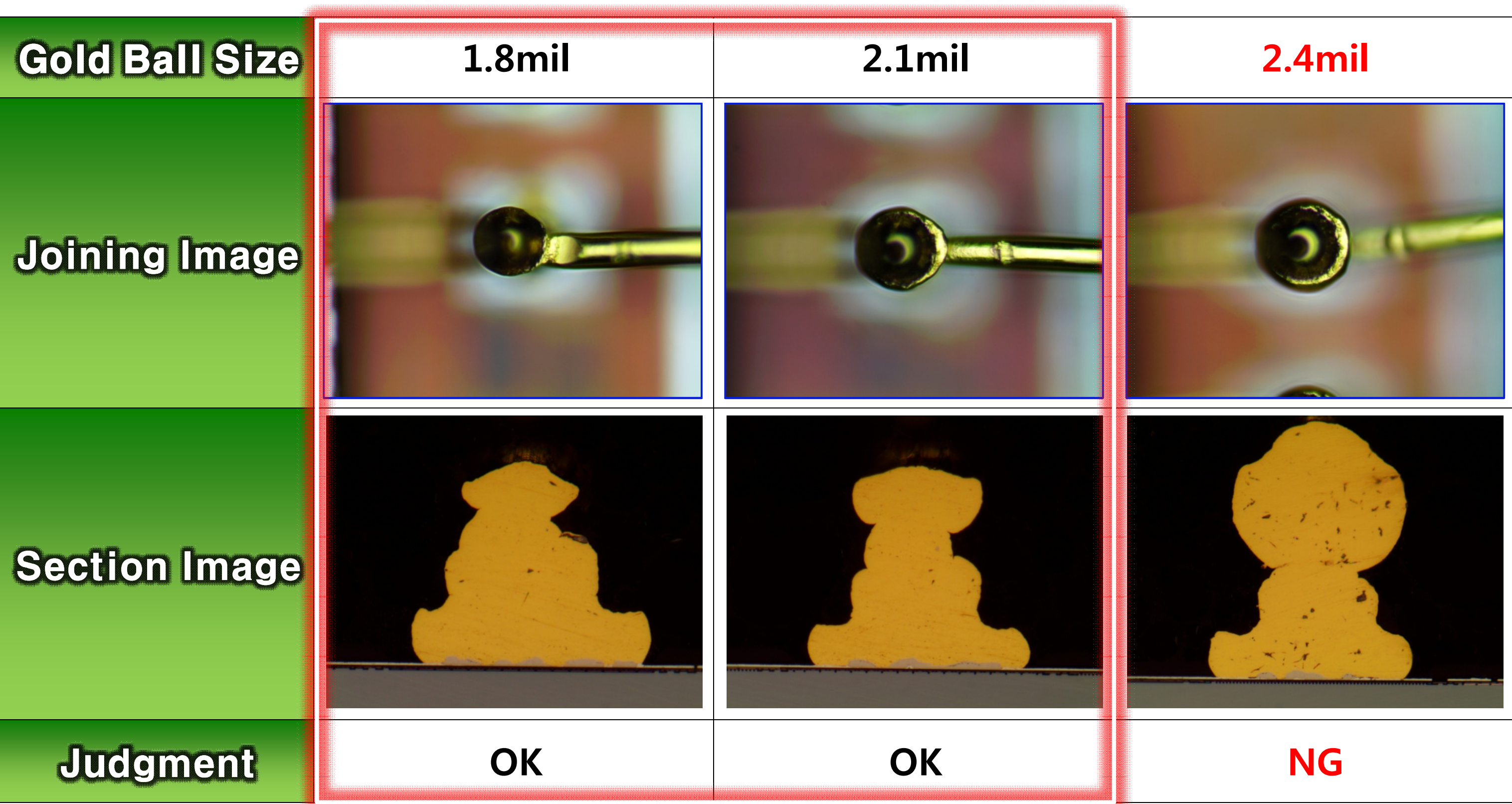
X-elements

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

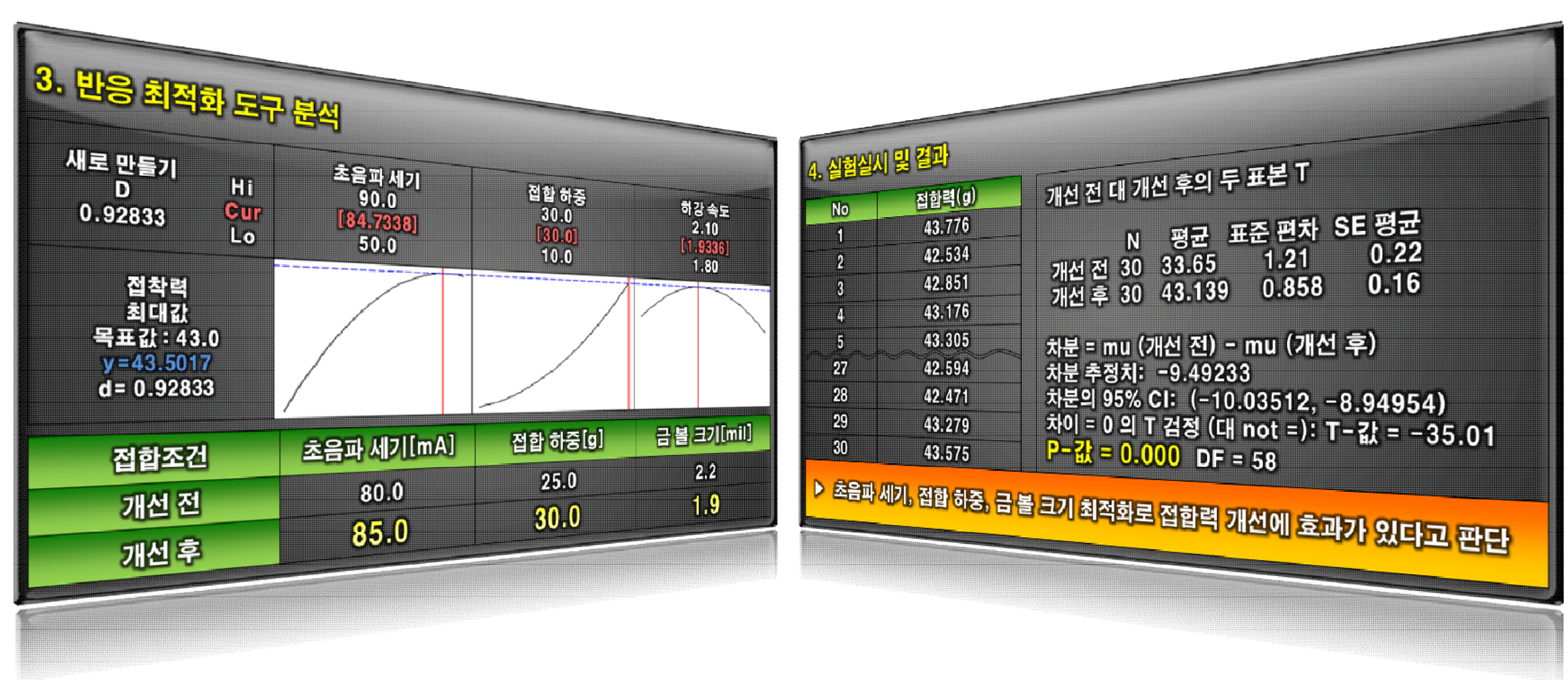
4.1. Validation X-elements (Top Gold Ball Size)

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



5. Apply ideas

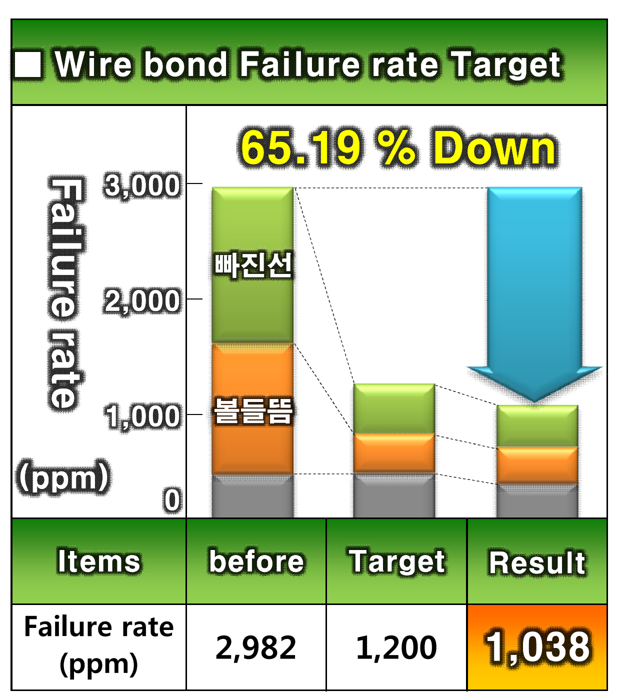
5.1. Design of Experiments



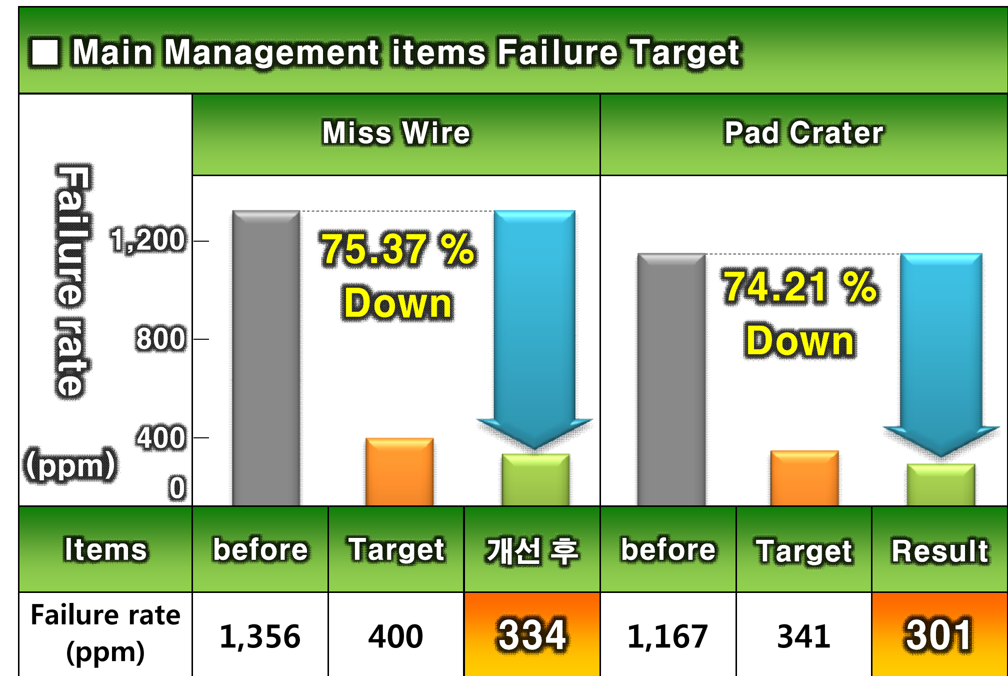
Optimization performed

6. Results

6.1. performance indicator



Items	before	Target	Result
Failure rate (ppm)	2,982	1,200	1,038



Items	Miss Wire before	Miss Wire Target	Miss Wire 개선 후	Pad Crater before	Pad Crater Target	Pad Crater Result
Failure rate (ppm)	1,356	400	334	1,167	341	301

65.19 % Down

Thank you.