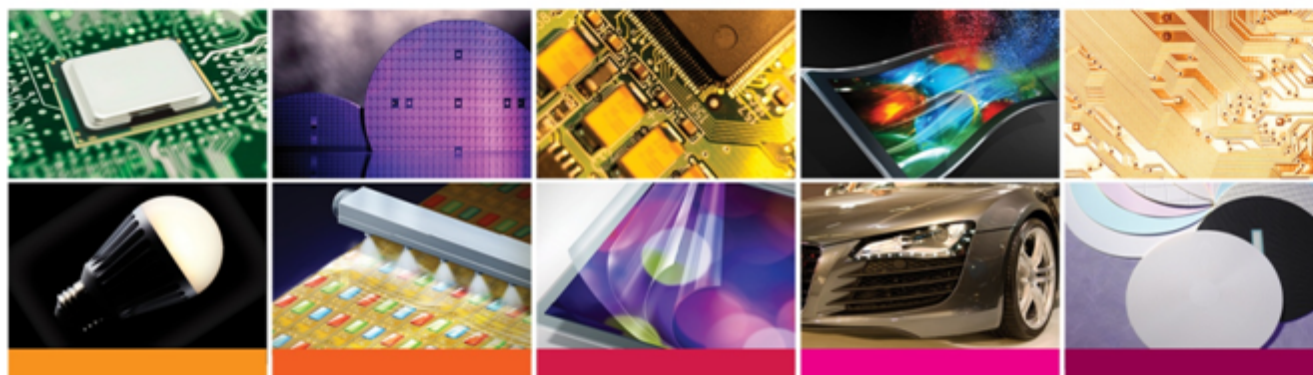




## Electronic Materials



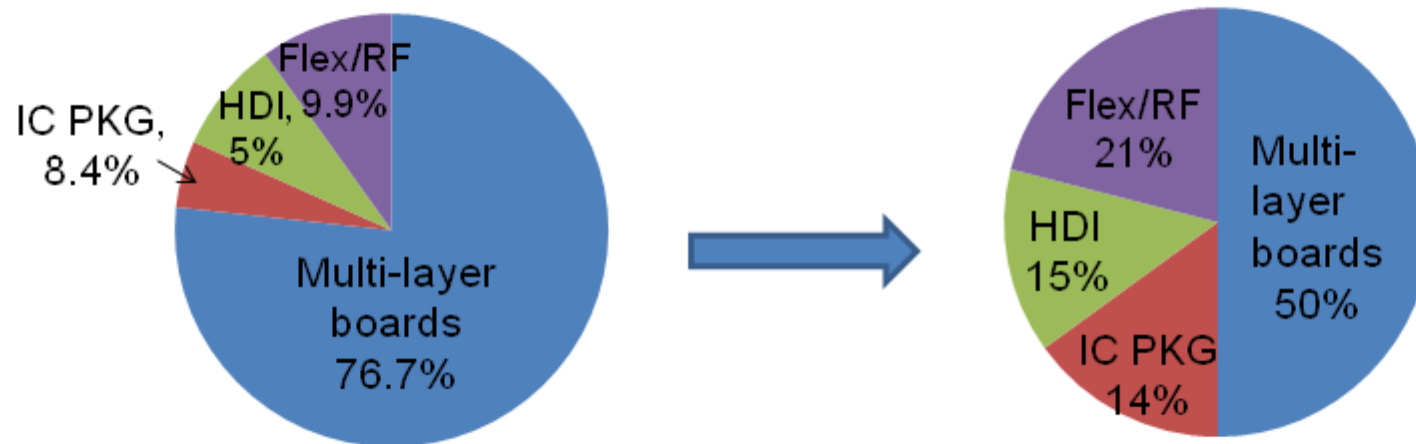
# CIRCUPOSIT™ 6530 CATALYST PROCESS FOR ELECTROLESS COPPER METALLIZATION

# Outline

- 1 INTRODUCTION**
- 2 DOW PROCESS KEY FEATURES
- 3 RESULTS and DISCUSSION
- 4 CONCLUSION
- 5 QUESTION & ANSWER

# Introduction

- Global PCB market trend towards advanced technology boards with excellent reliability requirement (High-density-interconnect, Integrated Circuit packaging substrate, and Flex/Rigid-Flex)



Global PCB Product Mix, YR 2000 (L) vs YR 2013 (R) (Source: Prismark)

- DOW provides new chemistries for the horizontal metallization of advanced boards
  - New ionic palladium CIRCUPOSIT™ 6530 Catalyst
  - New tartrate-based CIRCUPOSIT™ 6550 Electroless Copper

# DOW Ionic Catalyst Process

## Key Features

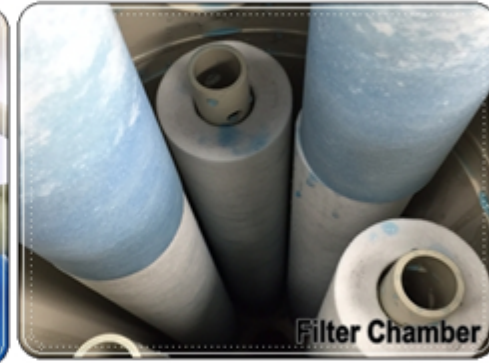
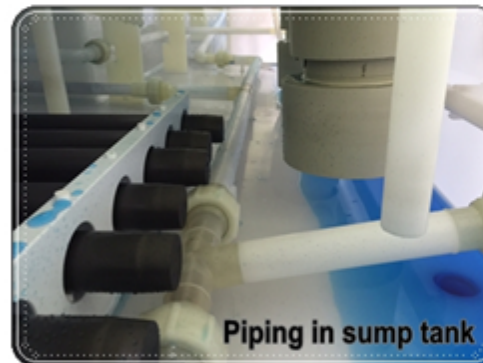
Long Catalyst Bath Life  
- Greater than 1 Month

Environmentally Friendly  
- Cyanide Free and EDTA Free

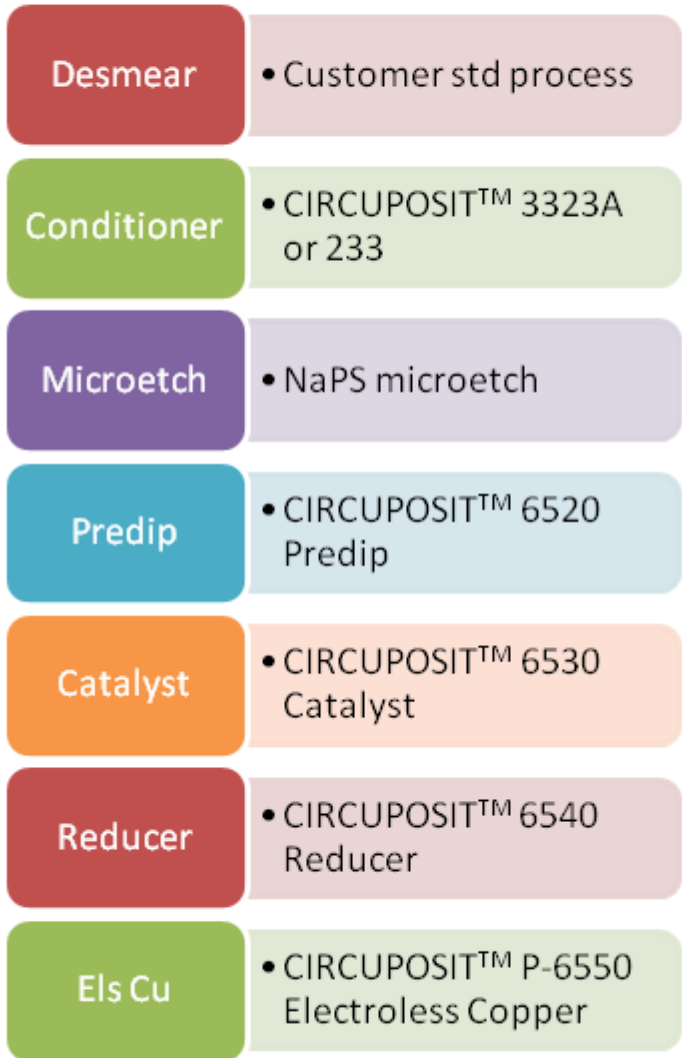


Excellent Coverage and Appearance

Stable tartrate-based e'less Cu bath.  
No plate out at SG=1.090



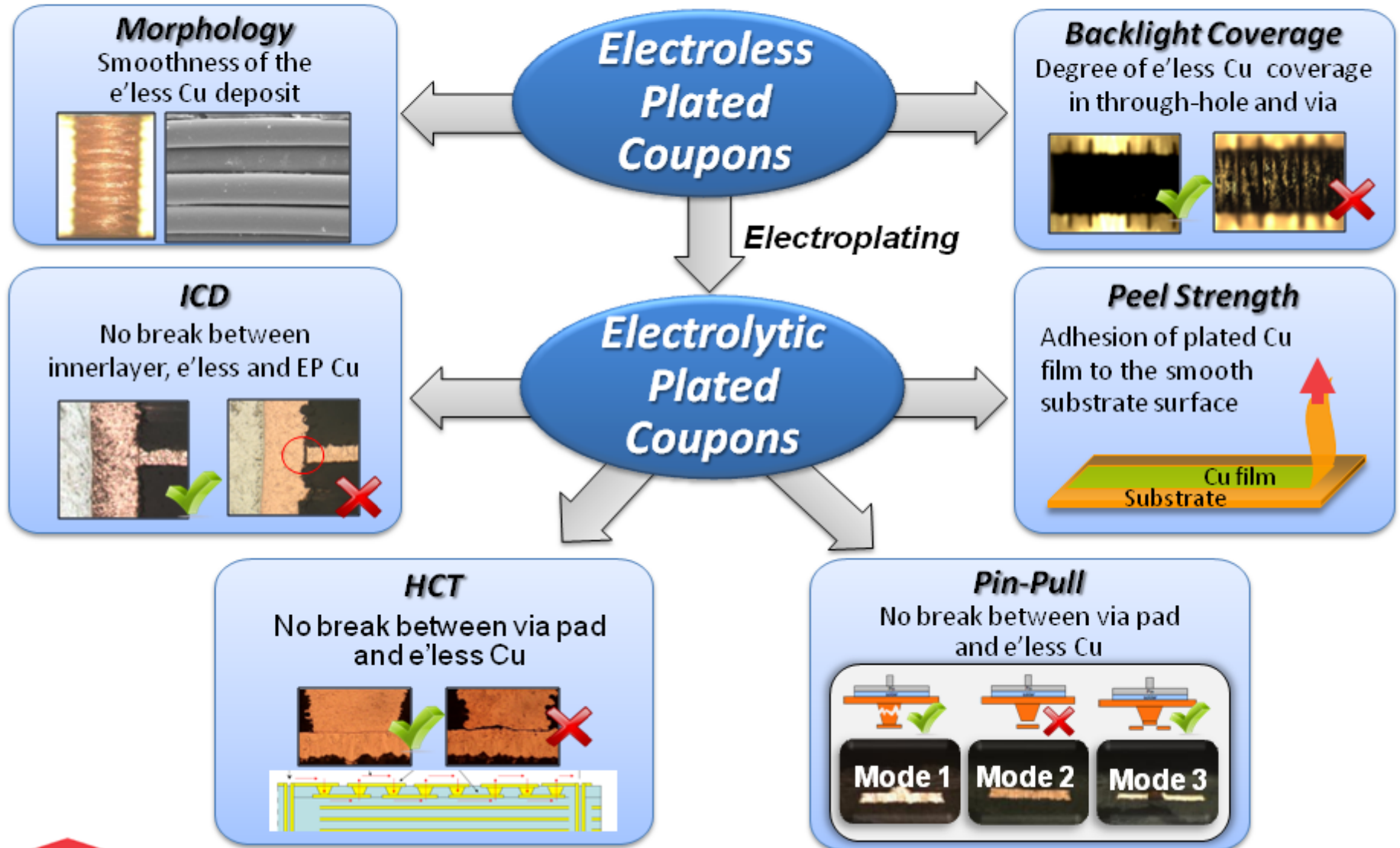
# DOW Ionic Catalyst Horizontal Process Flow



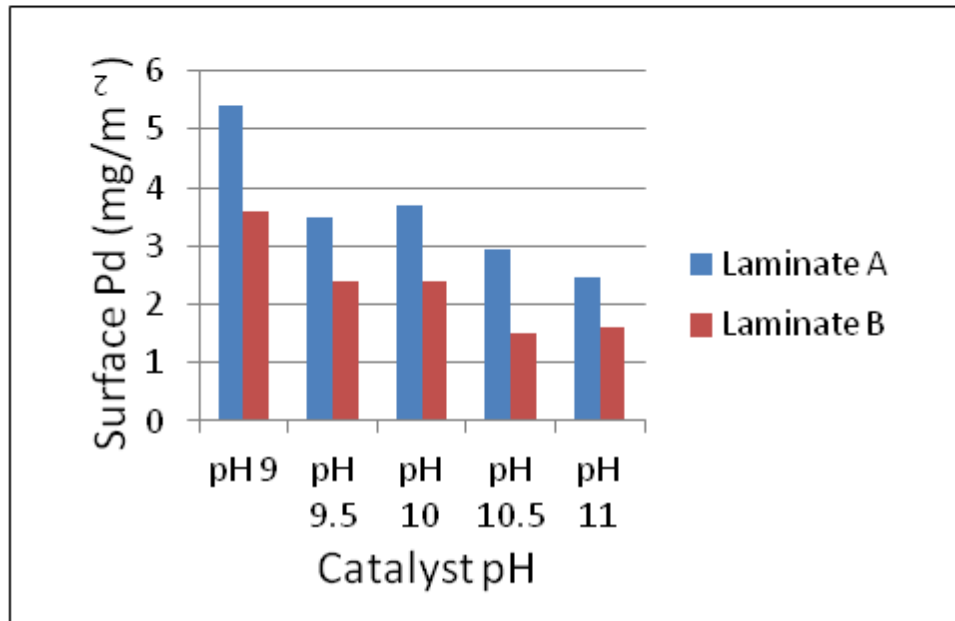
Key Chemicals	Control Parameters
CIRCUPOSIT™ 6530 Catalyst	Pd 200 ppm pH 9.0 – 9.5
CIRCUPOSIT™ P-6550 Electroless Copper	1) Cu 2.5 g/L 2) Rochelle salt 3) NaOH 4) HCHO 5) SR 6) SG =1.04-1.09
Baths	Make up Terms
Conditioner	7 days or Cu > 500ppm
Microetch	Cu > 15g/L
Predip	3 - 4 days or Cu > 150ppm
Catalyst	~ 1 month
Reducer	3 - 4 days
Electroless Copper	Weekly maintenance with 1/3 dilution. Re-make every 4 weeks or SG over 1.09



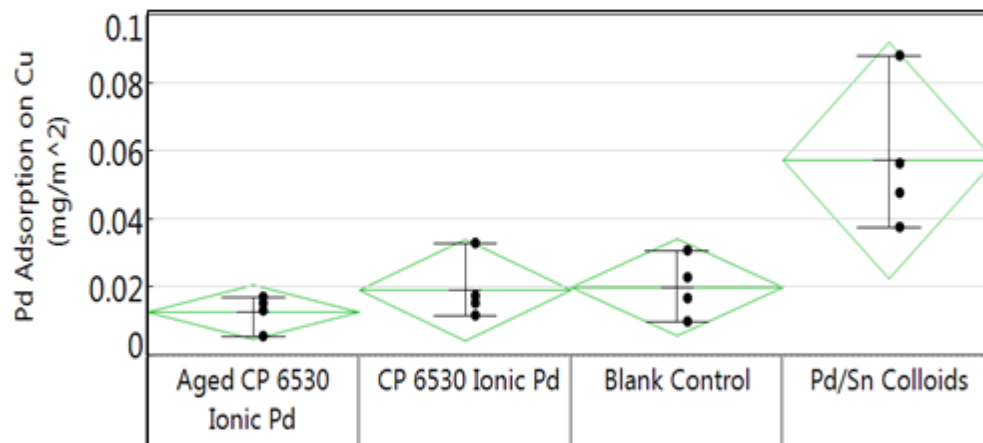
# Plating Performance Evaluation



# CIRCUPOSIT™ 6530 Catalyst Adsorption



- Catalyst adsorption on laminate surface is dependent on pH and laminate type
  - Backlight also depends on pH
  - The optimal pH range for the CP6530 ionic catalyst is 8.5 – 9.5

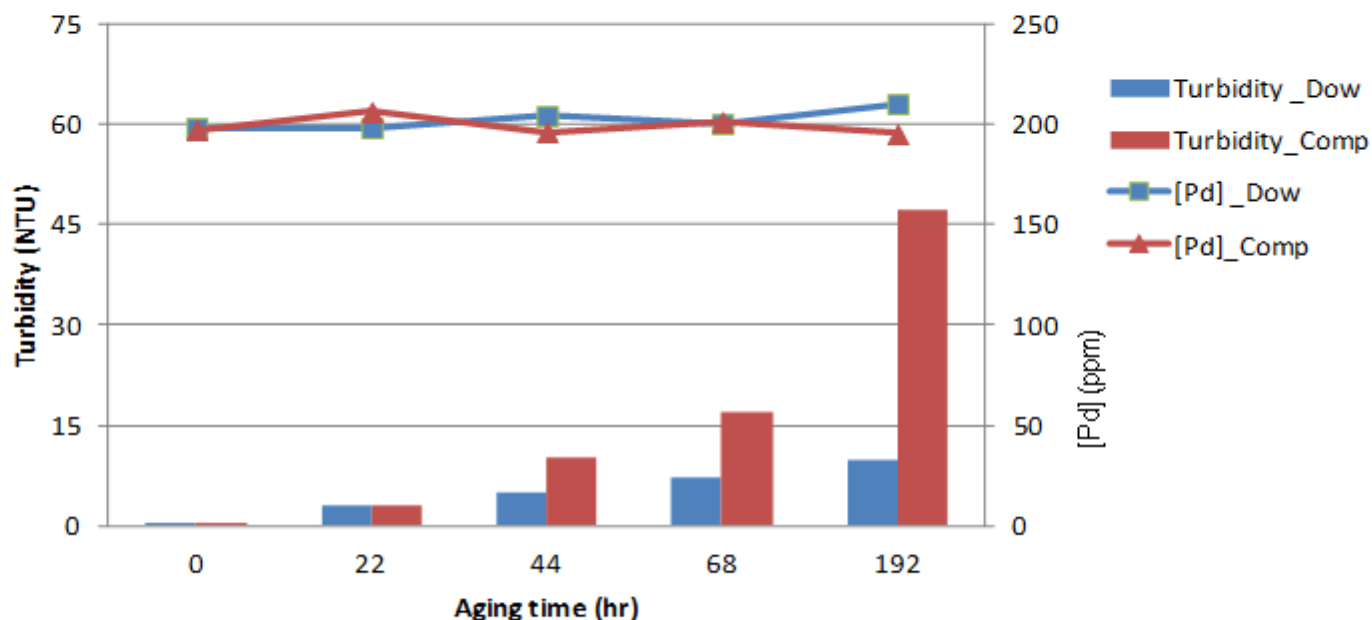


- No Pd adsorption of ionic catalyst to Cu surface
  - Pd analysis same for ionic catalyst and blank control
  - Aged catalyst (50 °C for one month) also showed no adsorption on Cu surface



# DOW Ionic Catalyst Process– Excellent Stability

## Catalyst stability comparison



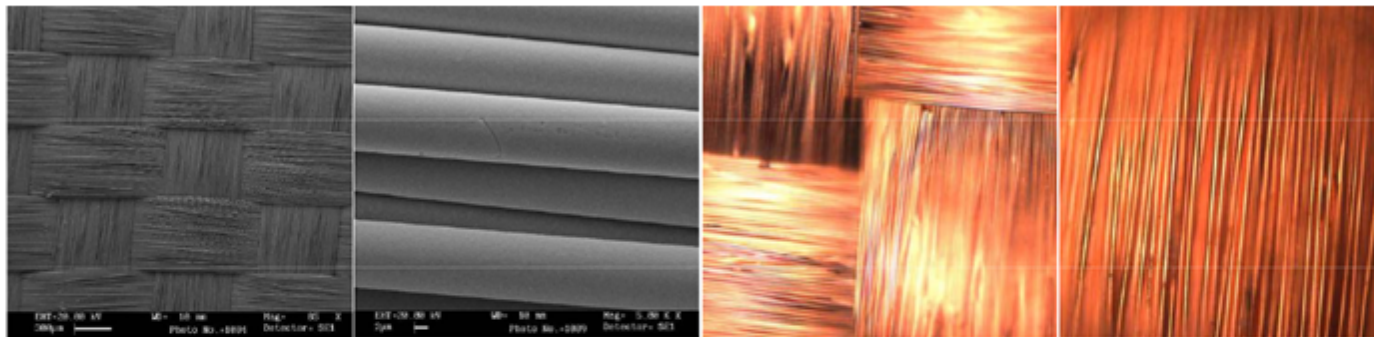
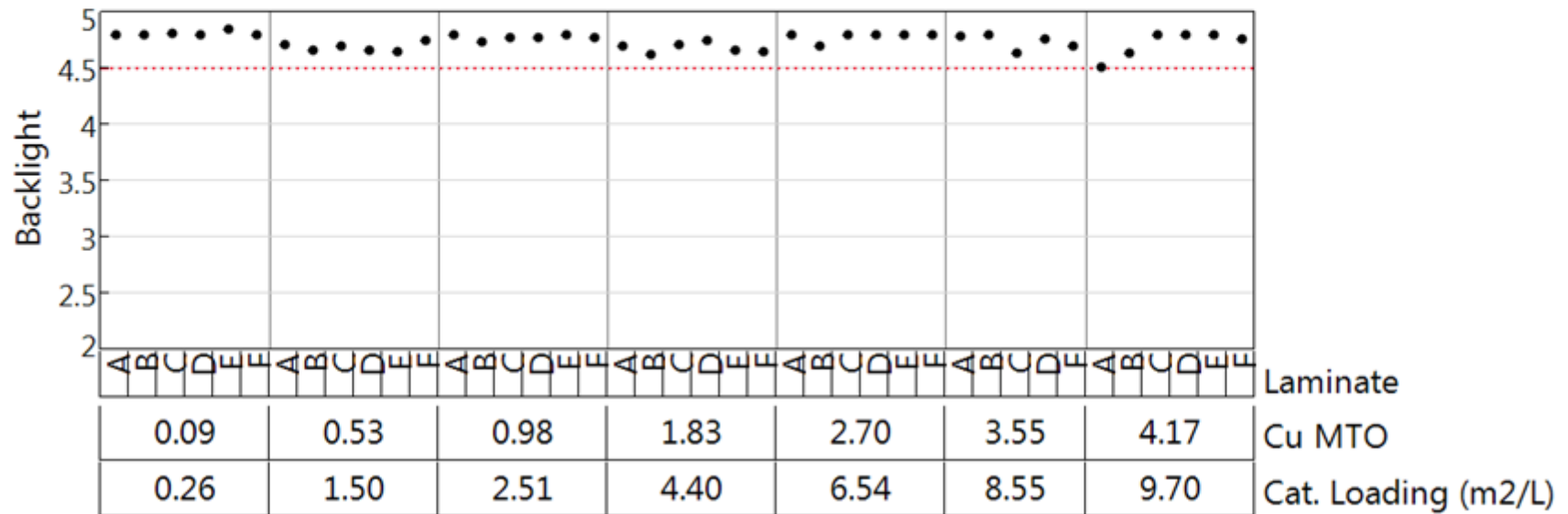
Catalyst	Items	Starting	Aging 22h	Aging 44h	Aging 68h	Aging 192h
Dow	Turbidity /NTU	0.2	2.9	4.9	7.1	9.8
	[Pd] /ppm	198	198	204	200	210
Competition	Turbidity /NTU	0.4	4.0	10.0	17.1	47.0
	[Pd] /ppm	197	206	196	201	195

Aging condition: 40 °C heating with strong agitation.





# DOW Ionic Catalyst Process – Good Coverage

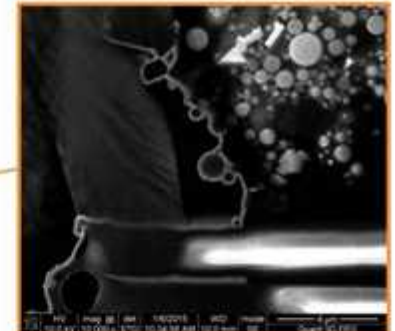
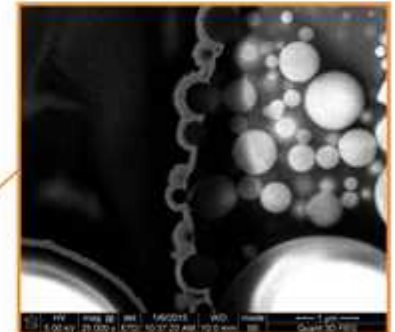


- Stable electroless copper coverage inside holes ( $\Phi$ : 1 mm) and smooth morphology on the glass

# DOW Ionic Catalyst Process– Coverage Cont'd



Thickness (nm)	Left	Right
Top	99 ±4	106 ±6
Middle	98 ±13	100 ±5
Bottom	78 ±15	70 ±7



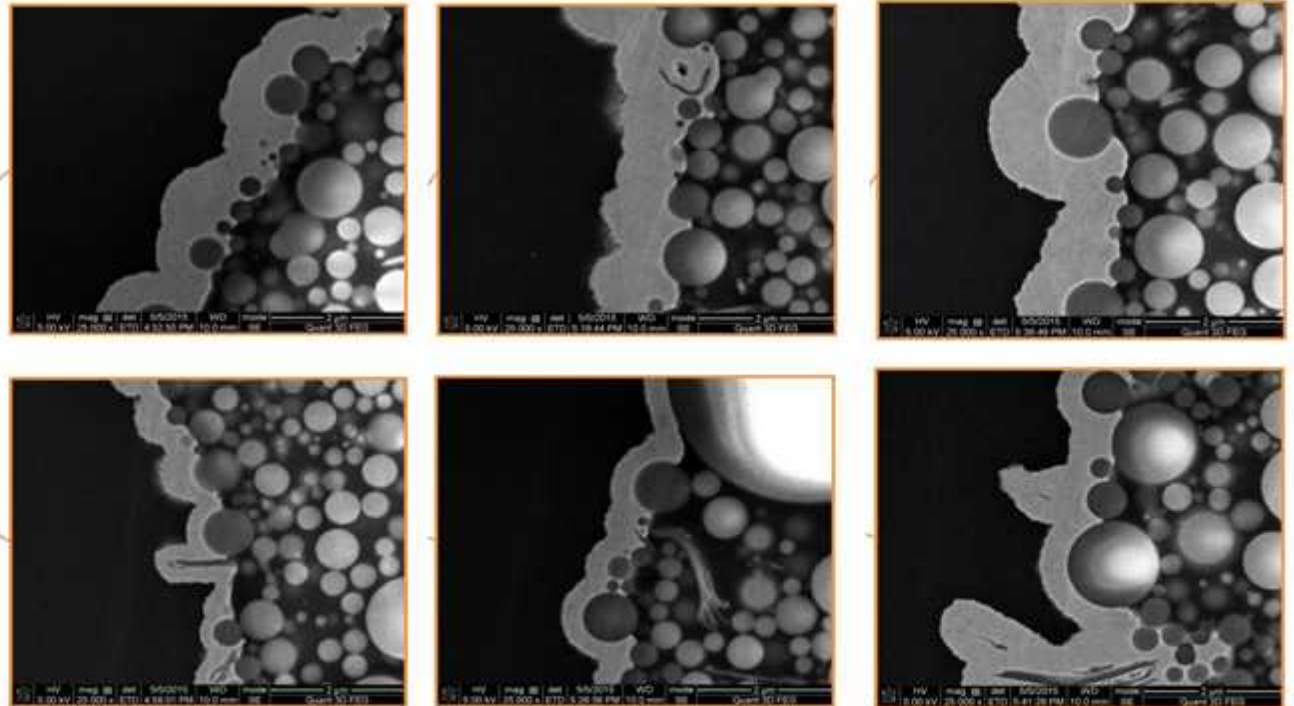
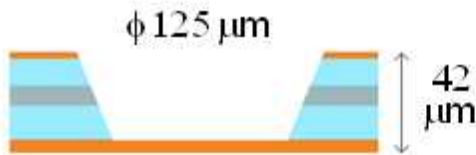
- Full electroless copper coverage inside blind vias

Nickel Free Electroless Copper Bath was used



# DOW Ionic Catalyst Process– Via Thickness

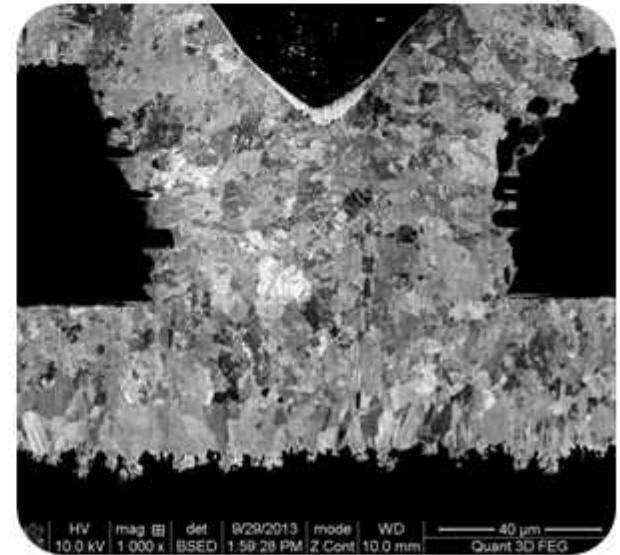
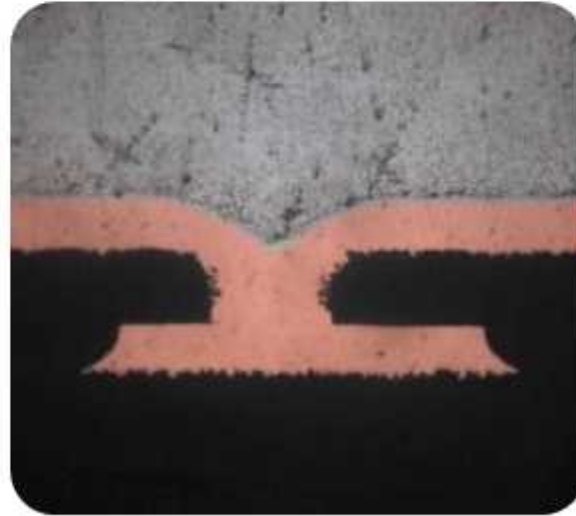
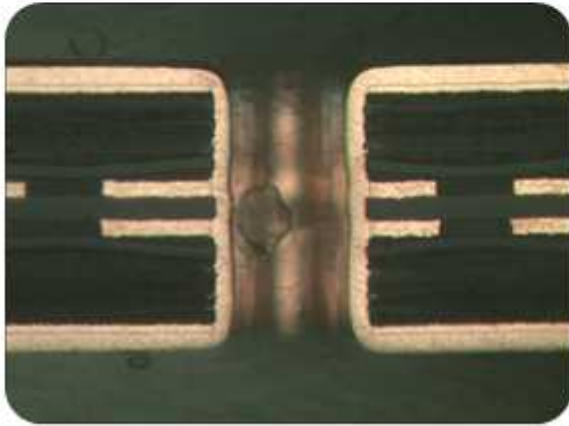
Line Speed (eCu dwell time)	1.0m/min (8.7min)		0.8m/min (11min)		0.6m/min (14.5min)	
Thickness (nm)	Left	Right	Left	Right	Left	Right
Top	550 ± 74	530 ± 30	740 ± 60	810 ± 112	910 ± 42	825 ± 90
Bottom	205 ± 16	221 ± 24	320 ± 40	221 ± 24	465 ± 146	389 ± 14



Electroless Copper Bath containing Nickel (typically 150 - 200 ppm) was used



# DOW Ionic Catalyst Process– Excellent Reliability



- No through-hole or blind via ICDs
- Good grain transfer from the target pad to the via copper
- 100% Pin-pull pass rate with line speed of 0.6 – 1.5 m/min
- HCT break time > 60 s @ 2.3 A

## Additional Performance Test Results

	Test Items and Conditions	Results
HDI	Hot oil shock test (260 °C x 10 sec → IPA dipping 20 °C x 10 sec) x 10 cycles	All Pass 1) No copper plating void 2) No barrel and foil crack 3) No separation in through hole
	Thermal shock cycle test (- 55 °C x 15 min ↔ 125 °C x 15 min) x 100 cycles	
	IR reflow test (240 peak x 5 cycles)	
PKG	PCT test (121 °C x 100% x 2 atm) → 96 hrs	Pass
	Thermal shock cycle test (- 55 °C x 15 min ↔ 125 °C x 15 min → 500 cycles)	Pass
	HAST test (85 °C x 85% → 168 hrs)	Pass

# DOW Ionic Catalyst for SAP Application

Desmear

• Customer std process

Cleaner

• AL-Chelate™

Microetch

• NaPS microetch

Predip

• CIRCUPOSIT™ 6520  
Predip

Catalyst

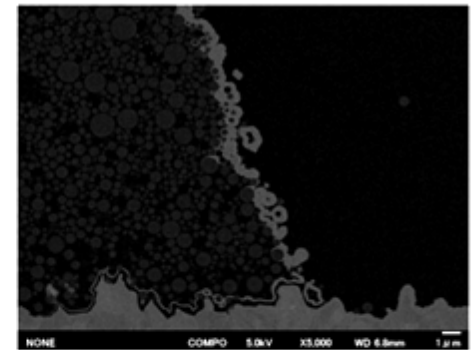
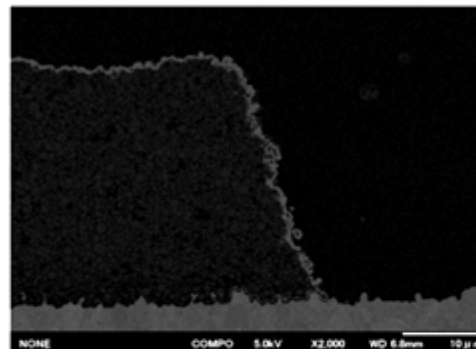
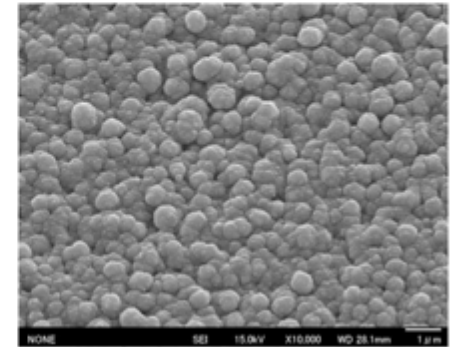
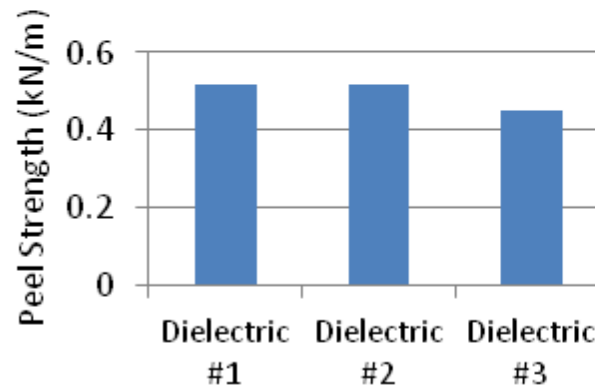
• CIRCUPOSIT™ 6530  
Catalyst (100 ppm Pd)

Reducer

• CIRCUPOSIT™ 6540  
Reducer

Els Cu

• Electroless Copper



- High peel strength on ABF substrates
- Uniform copper deposit
- Full electroless Cu coverage inside blind vias ( $\phi 50 \mu\text{m} \times 30 \mu\text{m}$ )

# Conclusion

- DOW has commercialized the ionic catalyst CIRCUPOSIT™ 6500 process for horizontal copper metallization
- With features:
  - Excellent stability of the ionic catalyst and tartrate-based electroless Cu baths
  - Good electroless Cu coverage inside THs and BMVs
  - Smooth Cu deposit morphology
  - Excellent reliability with no ICDs in THs and BMVs
  - 100% pin-pull pass rate
  - HCT > 60 s break time at 2.3 A
  - Good peel strength and uniform deposit on smooth substrate in the SAP process



# Q & A