Next Generation Electroplating Technology for High Planarity, Minimum Surface Deposition Microvia Filling

October 2012

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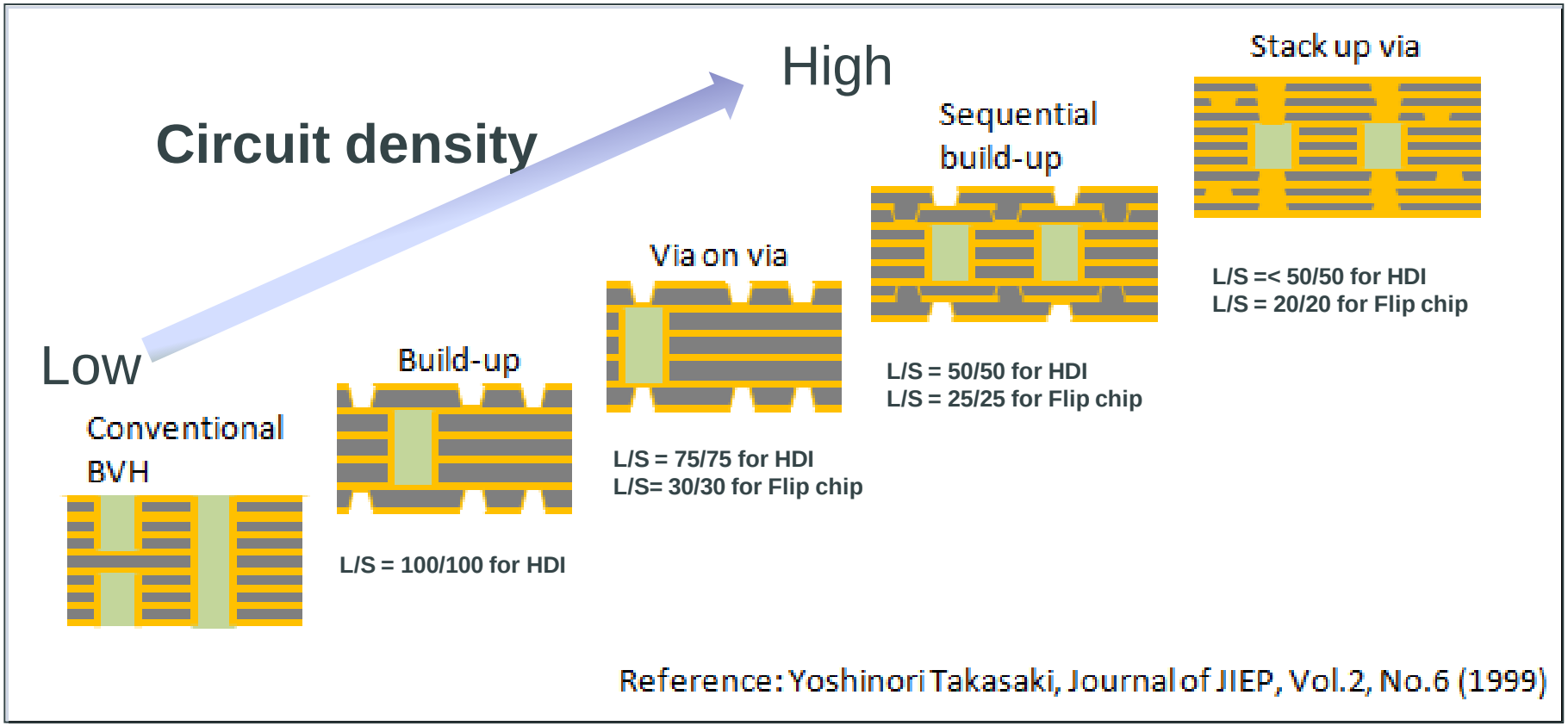
Introduction



Year

Introduction - Electronic Application Segments

Growth Drivers

Consumer demands are always focused on higher performance, lower cost and safety.

Computing

$417Bn

Faster chips,
Higher Clock Speed
Lower Cost : All In One PC
Low Voltage : CULV

Communication

$297Bn

Lower cost
Higher functionality
3G/4G Mobile High data rate

Automotive

$105Bn

Safety, Reliability
Driverless actions
Increased electronic content

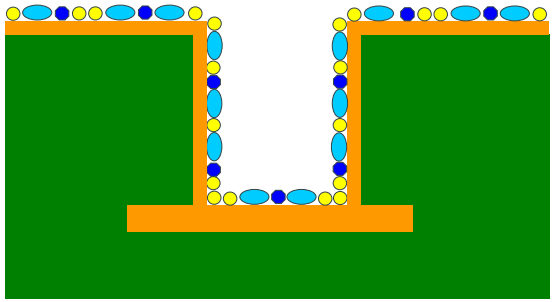
Consumer

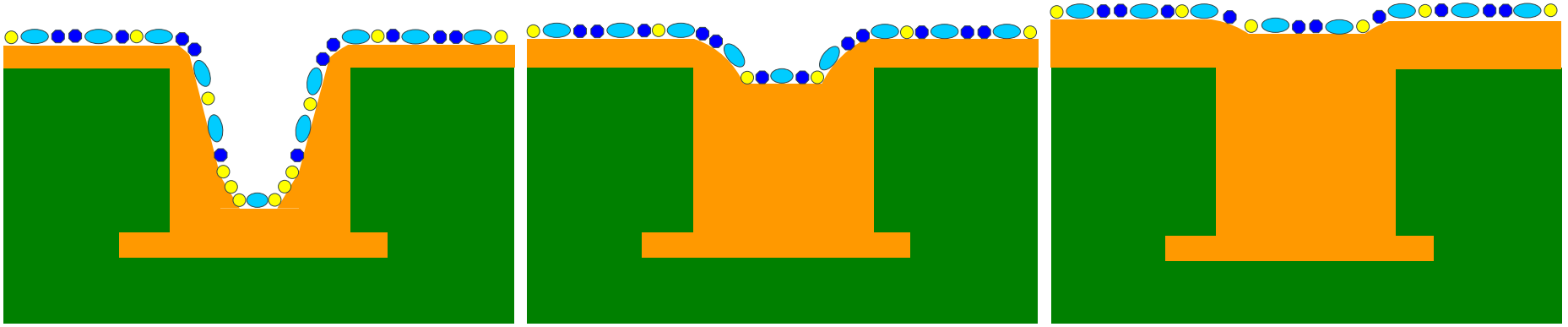
$138Bn

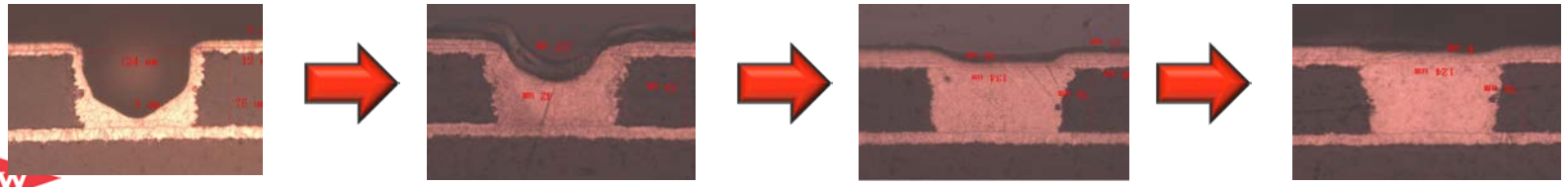
LCD TV
Digital Images
Game Consoles

Prismark Forecast

Introduction – Microvia Filling Mechanism

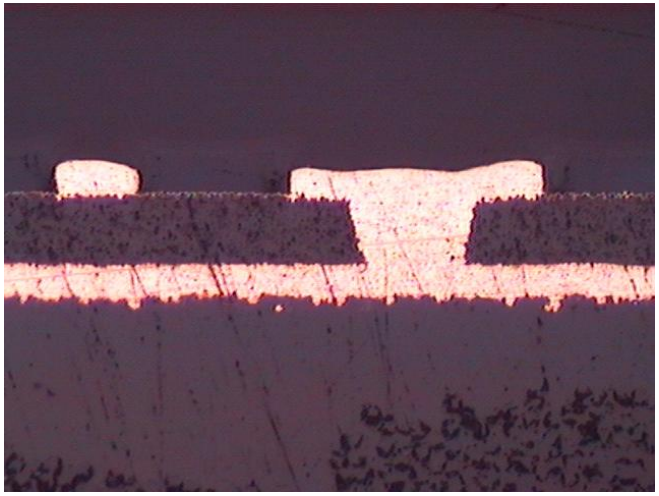






Key Factors Affecting Performance

Proper additive control



Optimum ratio of additives

Good via filling performance
Good surface morphology

Poor additive control

Unsuitable ratio of additives

Poor via filling performance
Uneven copper deposition

Project Objectives

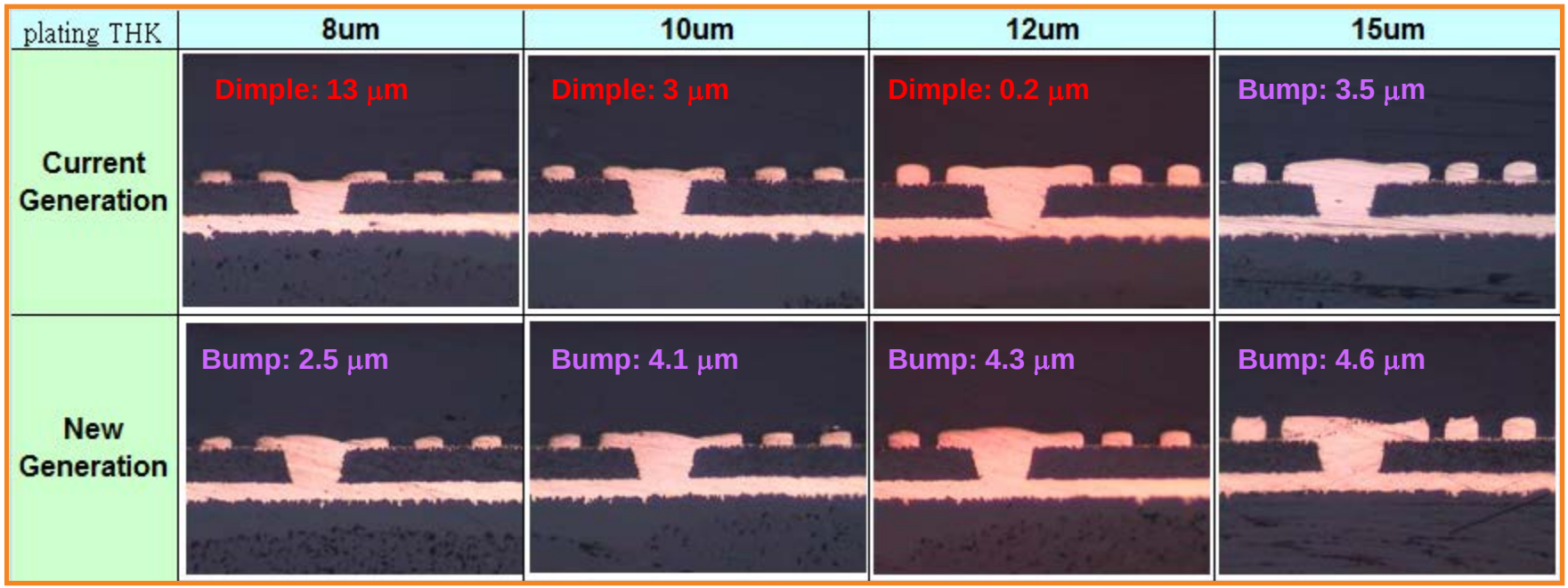
For Flip Chip Substrate Applications

- Microvia diameter: 50 – 75 µm
- Microvia dielectric thickness: 30 – 40 µm
- Plating current density: 15 – 25 ASF (1.5 – 2.5 ASD)
- Plating thickness: 10 – 15 µm
- Dimple dimension : ≤ 5 µm
- Trace convexity: ≤ 5 µm

For HDI Applications

- Microvia diameter: 90 – 110 µm
- Microvia dielectric thickness: 70 – 80 µm
- Plating current density: 15 – 25 ASF (1.5 – 2.5 ASD)
- Plating thickness: 12 – 18 µm
- Dimple dimension : ≤ 5 µm
- Trace convexity: ≤ 5 µm

Via Filling as a Function of Plating Thickness



Microvia diameter: 60 μm
Dielectric thickness: 30 μm

The new generation process can deliver excellent via filling performance at low plating thickness

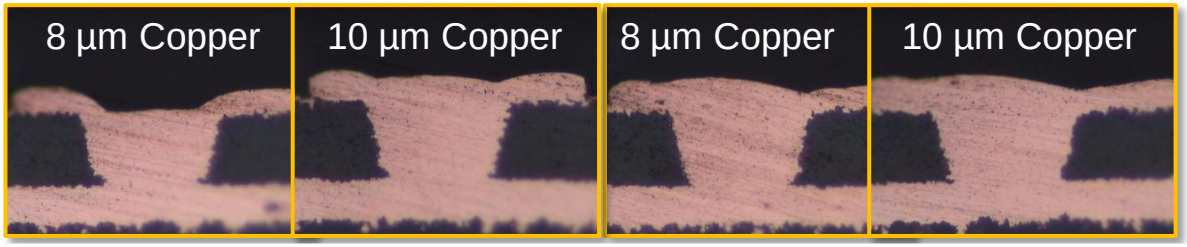
Via Fill Performance - Effect of Dry Film Leaching

	Dimple Performance (µm)			
	Current Generation		New Generation	
Plating Thickness (µm)	New Make up	Dry Film Leaching (48 hours)	New make up	Dry Film Leaching (48 hours)
8	**13.3**	**14.3**	**-2.5**	**-2.5**
10	**3.1**	**4.1**	**-4.1**	**-4.0**

Negative value = bump

Dimple

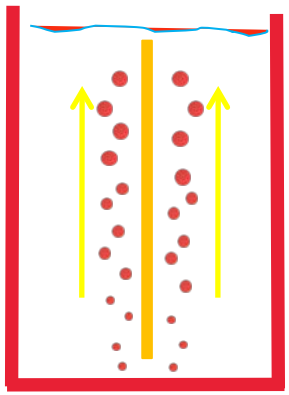
Bump

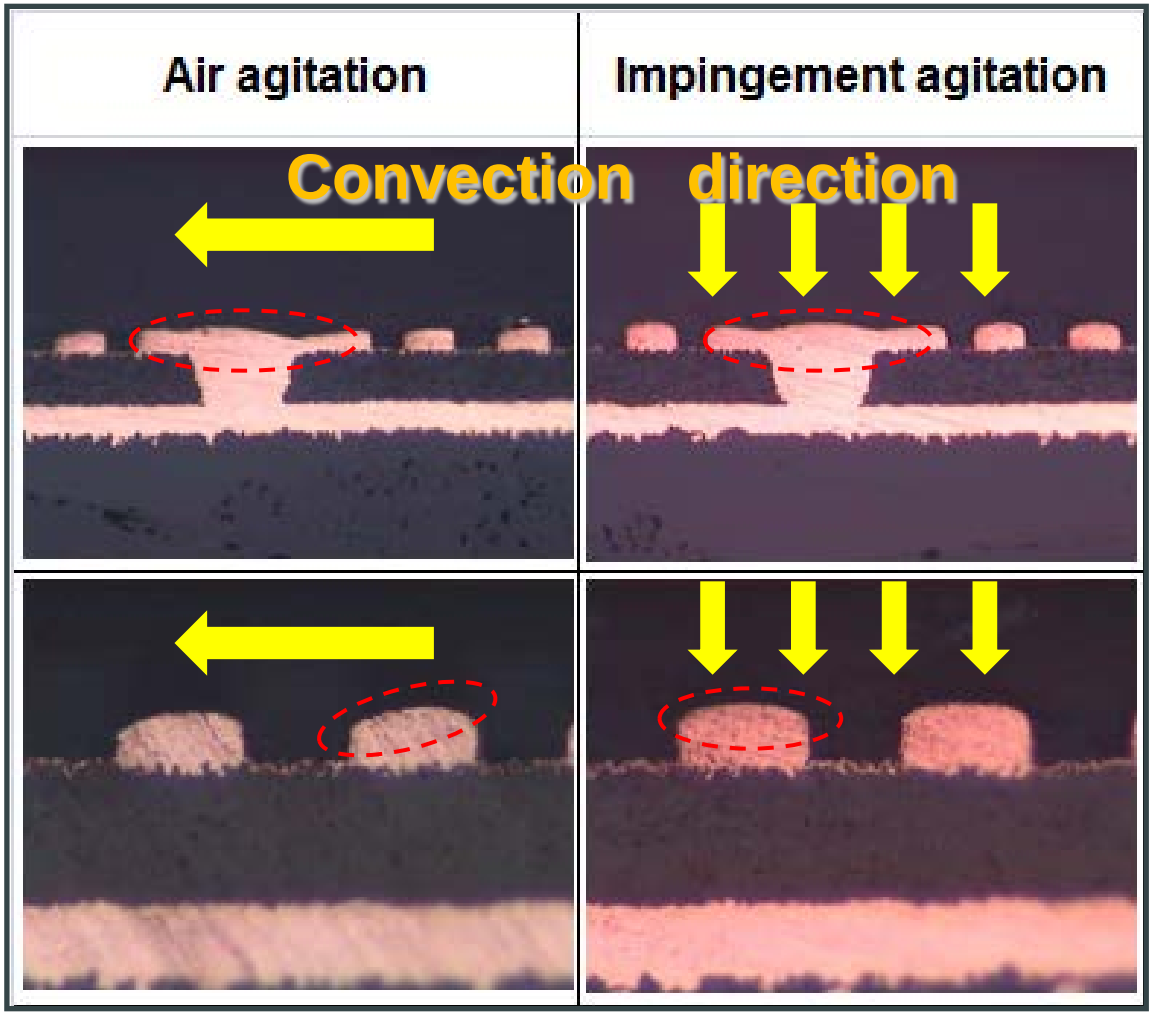


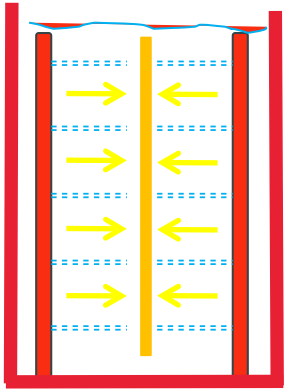
Dry Film Leaching Test
Dry Film: Asahi UFG-257
Loading: 20 dm^2/L
Immersion Time: 48 hours
Temp: 25°C

The new generation process maintains excellent via filling performance even after dry film leaching

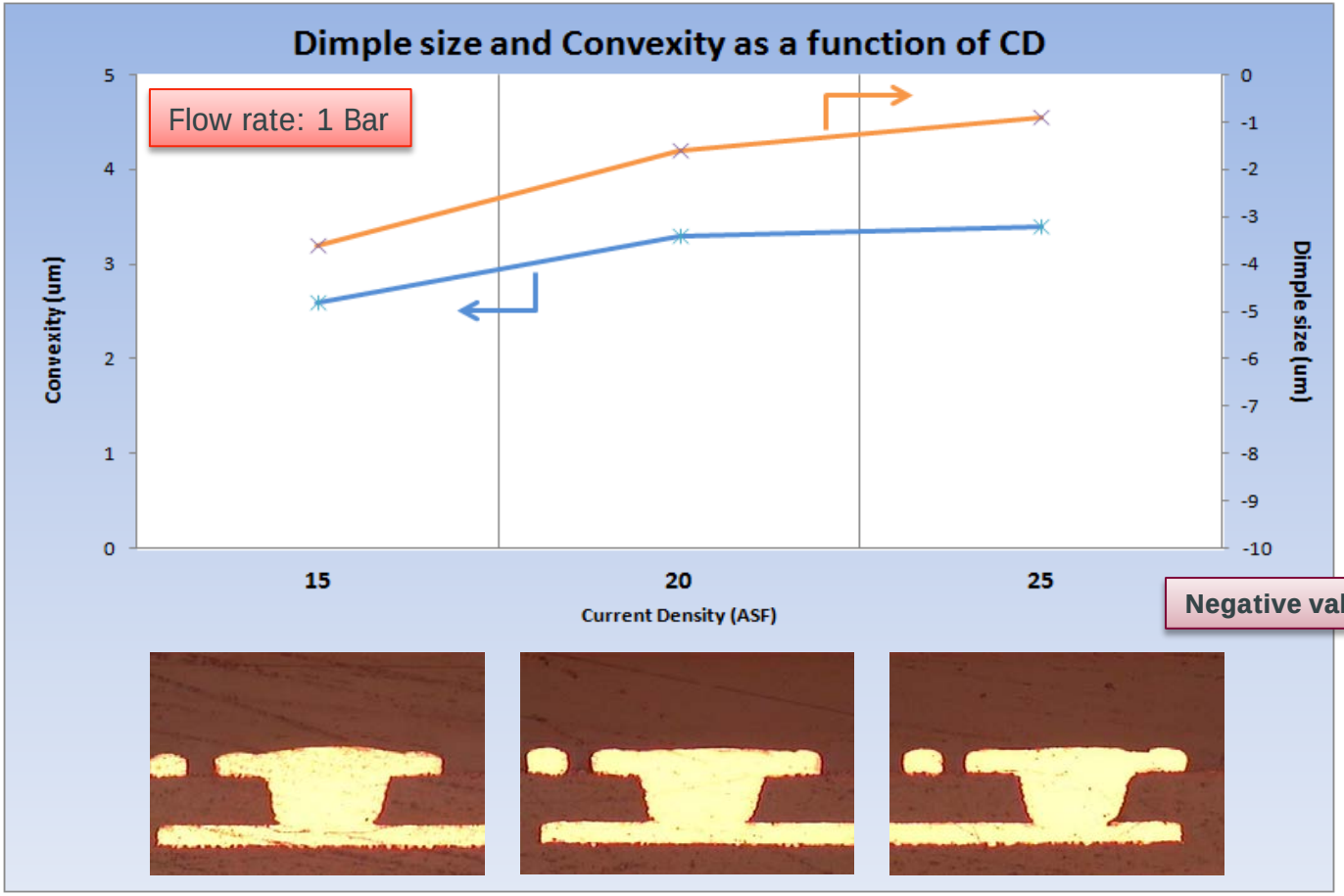
Influence of Solution Flow on Via Fill and Trace Profile







Performance as a Function of Current Density

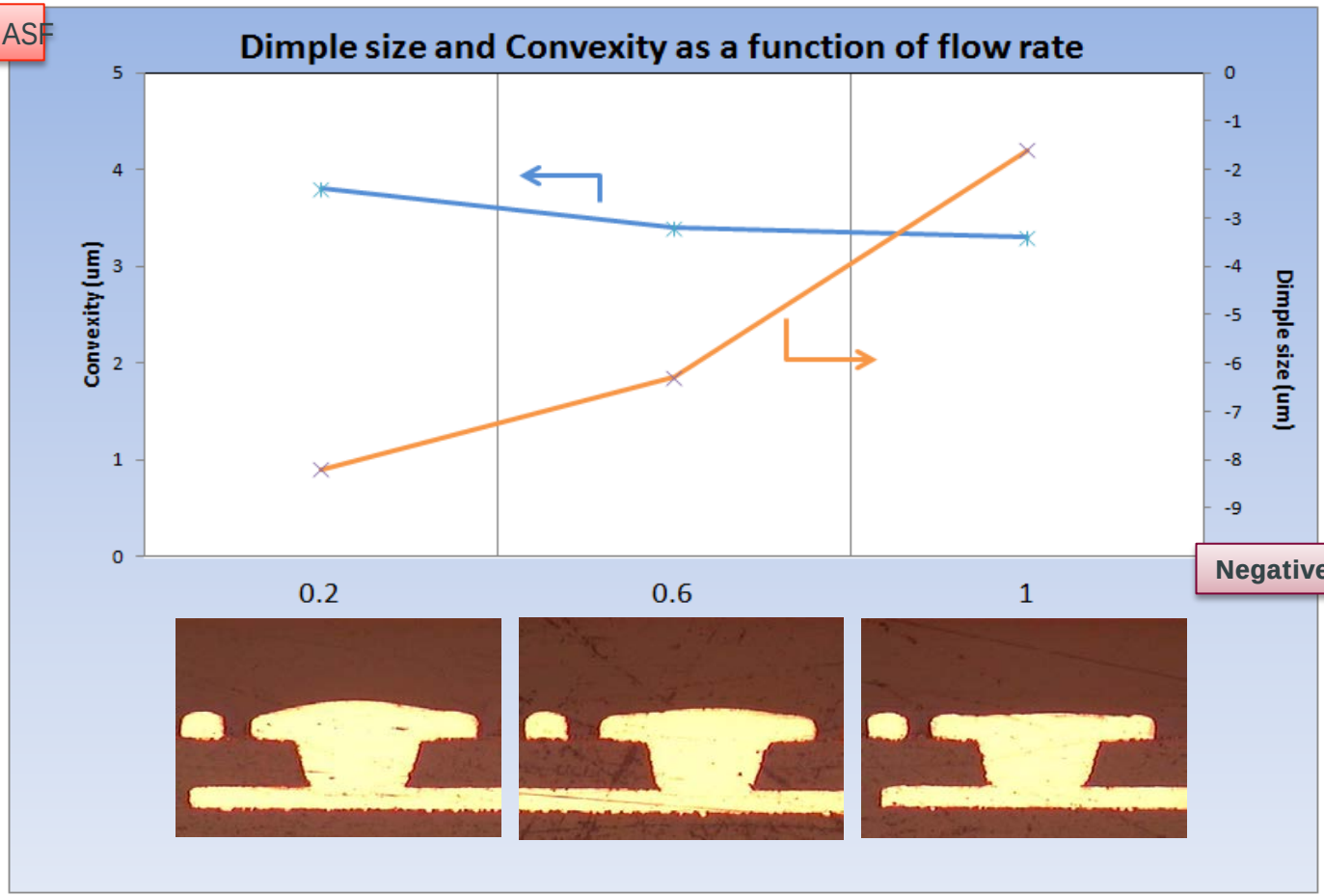


Via filling ability decreases as current density increases

Microvia diameter: 70 µm
Dielectric thickness: 30 µm
Plating thickness: 12 µm

Performance as a Function of Flow Rate

Current Density: 20 ASF



Negative value = bump

Via filling ability decreases at increased flow, but excellent filling performance is still retained at higher flow rates

Microvia diameter: 70 µm
Dielectric thickness: 30 µm
Plating thickness: 12 µm

Process Operating Parameters

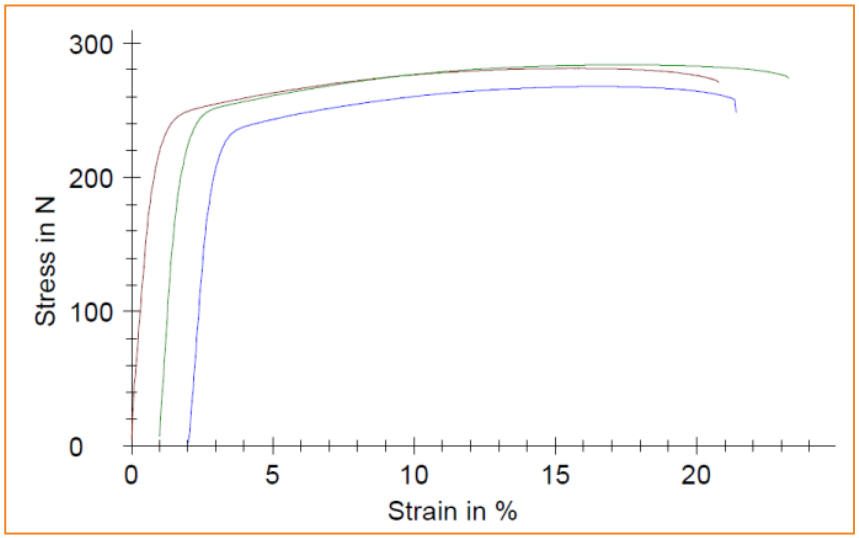
Parameter	Control	Range	Unit
$CuSO_4$	200	190 – 210	g/L
H_2SO_4	75	65 – 85	g/L
Cl^-	50	40 – 60	mg/L
Temperature	22	20 – 25	℃
Current Density	20	15 – 25	ASF

Additive Component	Monitored By	Analysis Method
Brightener	CVS	MLAT
Carrier	CVS	DT
Leveler	CVS	Response Curve

Deposit Physical Properties : Tensile and Elongation

Current Density: 20 ASF

	Bath Age	
	0 Amp-Hr/L	100 Amp-Hr/L
Tensile Strength (Kpsi)	44	45
Elongation (%)	21	20

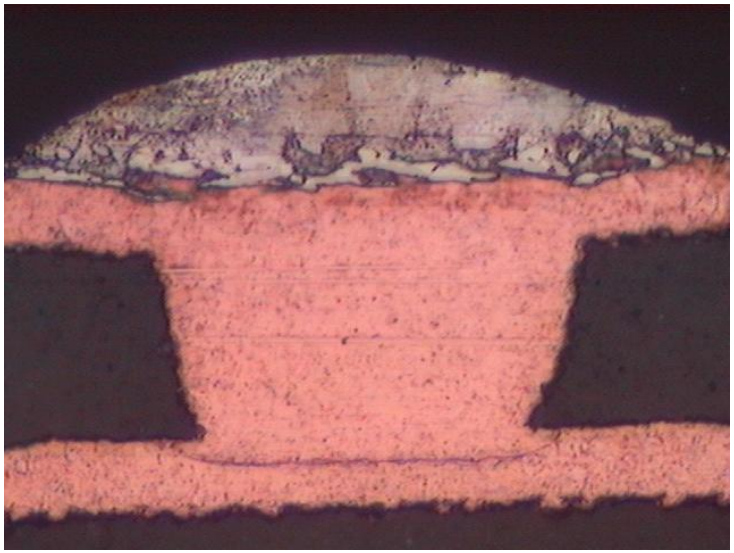


Tensile Strength and Elongation test profile

Reliability Performance: Solder Float Testing

Current Density: 20 ASF

	Bath Age	
	0 Amp-Hr/L	100 Amp-Hr/L
Solder Float Test (288 ℃, 10 sec, 6 cycles)	100/100 : Good	100/100 : Good



Cross section after solder float testing

Summary

- Excellent blind microvia fill performance with thin copper deposition thickness
- Excellent filling performance maintained at high flow rates
- Excellent deposit physical properties and interconnect reliability
- Current density range : 15 – 25 A/ft^2 (1.5 – 2.5 ASD)
- Highly leveled surface free of nodules and pits
- All bath additive components can be monitored by CVS

Thank You

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