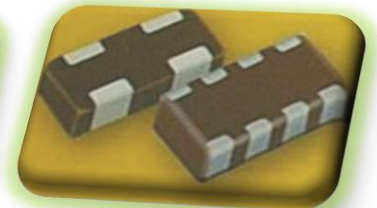
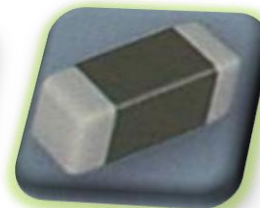
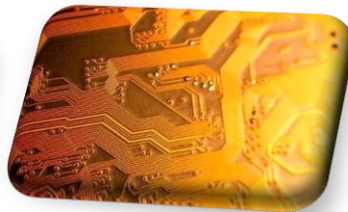
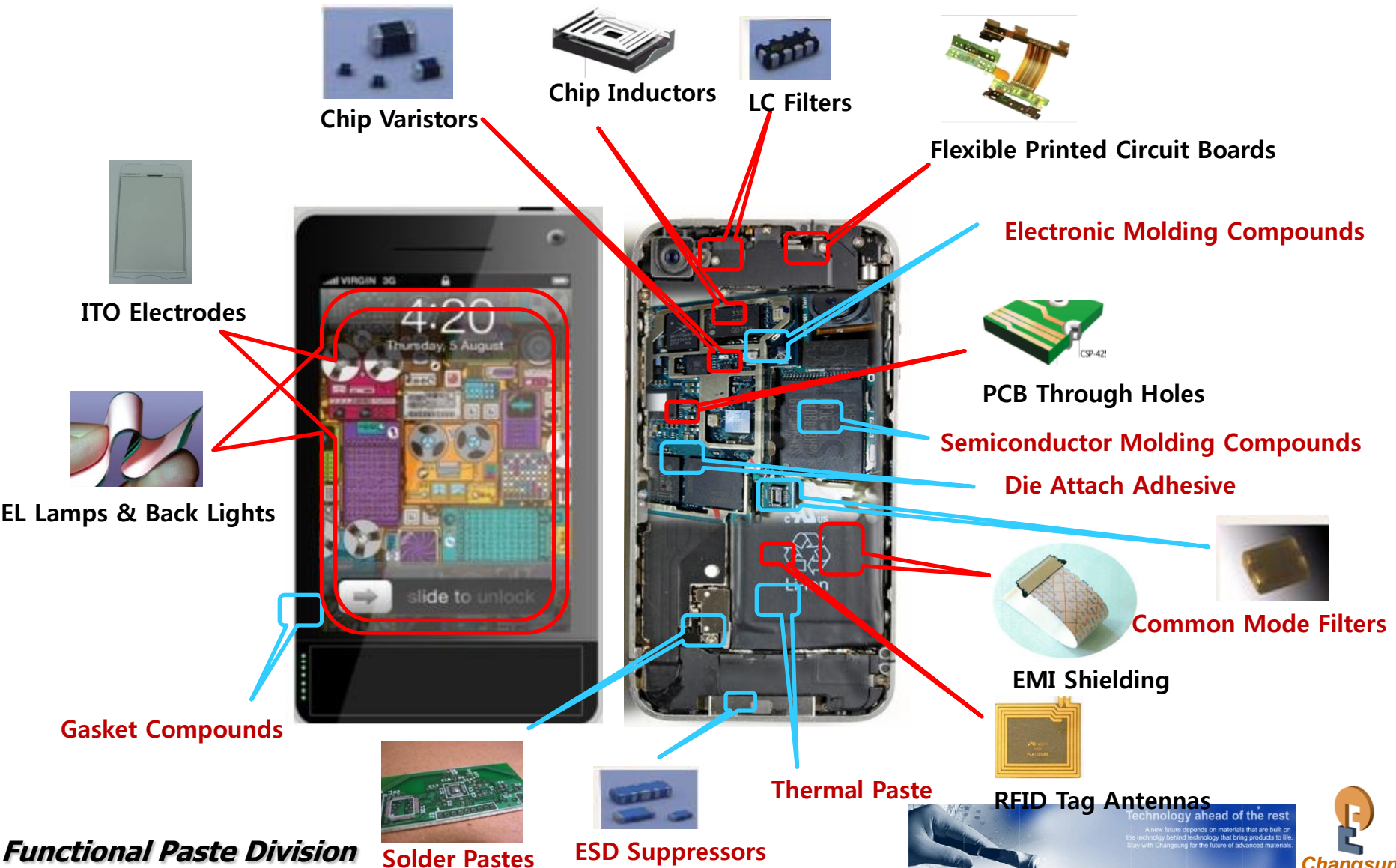


# CSC'S Functional Pastes


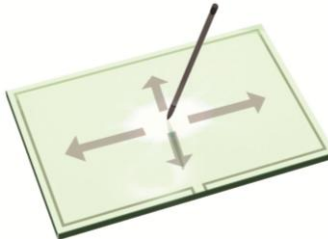
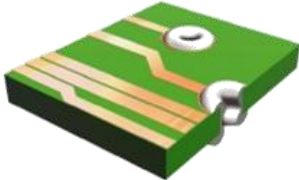
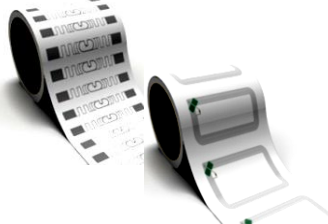


# Introduction of CSC Pastes

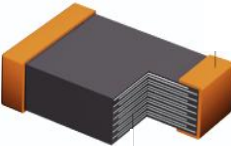
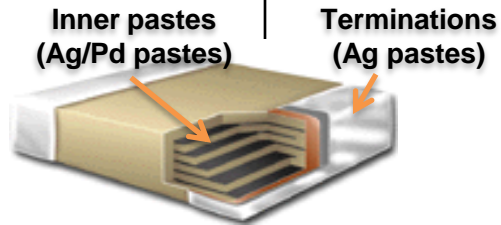


## Smart Phones & Conductive Pastes



# Functional Pastes I




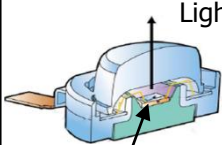
Items	Characteristics	Applications	
<b>Pastes for Flexible Circuits</b>	<ul style="list-style-type: none"> <li>• For Membrane Touch Switches</li> <li>- High level of electric conductivity</li> <li>- Excellent flexibility</li> <li>- High level of surface hardness and wear resistance</li> <li>- UL certificated</li> <li>- Halogen free</li> </ul>	<ul style="list-style-type: none"> <li>• Computer keyboards</li> <li>• Remote controls</li> <li>• Control panels for home electronics</li> <li>• Heating elements</li> <li>• EMI shielding</li> </ul>	
<b>Pastes for Touch Screens</b>	<ul style="list-style-type: none"> <li>• Electrodes for Touch Screens</li> <li>- Good printing characteristics</li> <li>High level of conductivity</li> <li>- Excellent adhesion to ITO Electrodes and PET films</li> <li>- Fine line resolution, High level of surface hardness and wear-resistance</li> <li>- Halogen free</li> </ul>	<ul style="list-style-type: none"> <li>• Touch Screens</li> </ul>	
<b>Pastes for PCBs</b>	<ul style="list-style-type: none"> <li>• For PCB Silver Through Holes</li> <li>- High level of conductivity</li> <li>- High level of reliability</li> <li>- Good adhesion to PCBs</li> </ul>	<ul style="list-style-type: none"> <li>• CDs, DVD ROMs</li> <li>• Remote controls</li> <li>• Electronic toys</li> </ul>	
<b>Pastes for RFID Antennas</b>	<ul style="list-style-type: none"> <li>• High level of conductivity</li> <li>• Excellent adhesion to PET, PI and paper</li> <li>• Good level of flexibility</li> <li>• High pattern definition</li> <li>• Very dense and high surface hardness</li> <li>• High level of reliability</li> </ul>	<ul style="list-style-type: none"> <li>• 900MHz and 13.56MHz tag antennas</li> </ul>	

# Functional Pastes II

Items	Characteristics	Applications	
Pastes for MLCC	<ul style="list-style-type: none"> <li>• MLCC internal electrodes (Ni paste)                             <ul style="list-style-type: none"> <li>- High degree of dispersion</li> <li>- Smooth and even surfacing</li> <li>- Thin and uniform thickness</li> <li>- Low level of shrinkage</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Components for mobile equipment</li> <li>• Capacitors for rectifying</li> <li>• Home appliances</li> </ul>	
Pastes for Chip Varistors	<ul style="list-style-type: none"> <li>• Internal : Ag-Pd paste                             <ul style="list-style-type: none"> <li>- Cp controlled with the same metal contents</li> <li>- High level of reliability</li> <li>- Excellent electrical properties</li> <li>- Smooth and even surfacing</li> </ul> </li> <li>• External : Ag paste                             <ul style="list-style-type: none"> <li>- Excellent soldering ability</li> <li>- Strong adhesive strength</li> <li>- Pb free</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Components for mobile equipment</li> <li>• ESD Protection</li> </ul>	
Pastes for Chip Inductors	<ul style="list-style-type: none"> <li>• Chip Inductors' electrodes                             <ul style="list-style-type: none"> <li>- Good electrical conductivity</li> <li>- Good line resolution</li> <li>- Good thermal compatibility with substrates</li> <li>- Low sheet attack, Low level of odor</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Components for mobile equipment</li> <li>• RF module : noise suppressor</li> </ul>	
Pastes for Passive Components	<ul style="list-style-type: none"> <li>• Electrodes for passive components                             <ul style="list-style-type: none"> <li>- Good adhesion to ceramic substrates</li> <li>- Excellent electrical properties</li> <li>- High level of soldering resistance</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Patch antennas, Piezo etc.</li> <li>• Dielectric components : BPF etc.</li> <li>• Thermistors, LTCC</li> </ul>	



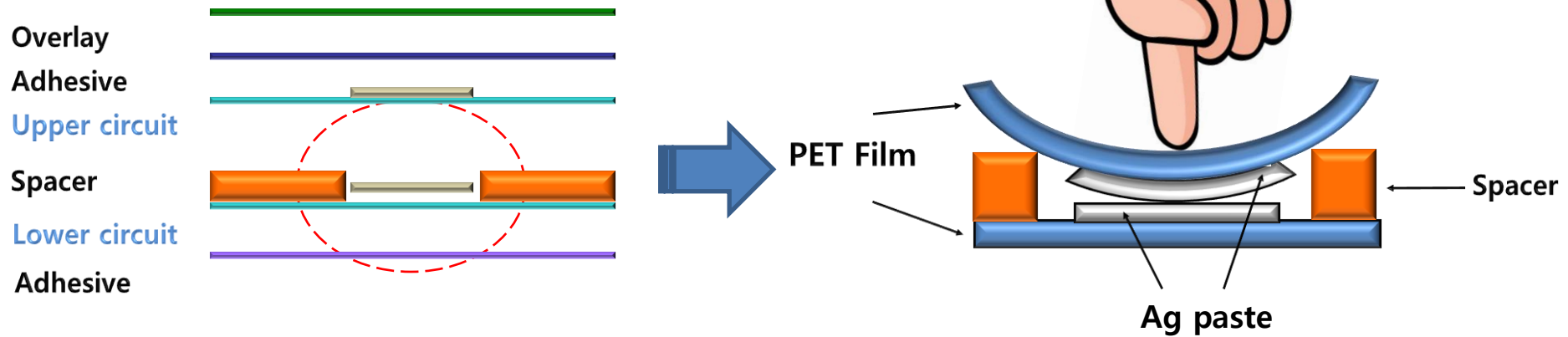
# Functional Pastes III

Items	Characteristics	Applications	
<b>Pastes for EMI Mesh Grids</b>	<ul style="list-style-type: none"> <li>• Good printing property</li> <li>• High level of conductivity</li> <li>• Excellent adhesion to PET, PI film</li> <li>• Able to control impedance matching</li> <li>• High level of reliability</li> </ul>	<ul style="list-style-type: none"> <li>• EMI Mesh Grids</li> </ul>	
<b>Pastes for Solar cell</b>	<ul style="list-style-type: none"> <li>• High level of reliability</li> <li>• Good adhesion to the Si wafer</li> <li>• Smooth and even surfacing</li> <li>• Excellent electrical properties</li> <li>• Pb free</li> </ul>	<ul style="list-style-type: none"> <li>• Front electrodes for solar cells</li> <li>• Back surface electrodes</li> </ul>	
<b>Carbon Nanotubes transparent conductive films</b>	<ul style="list-style-type: none"> <li>• Conductivity (<math>10 - 10^7</math> ohm/sq)</li> <li>• Optical transmittance</li> <li>• Good adhesion</li> <li>• Durability</li> <li>• Flexibility</li> <li>• Chemical resistance</li> </ul>	<ul style="list-style-type: none"> <li>• Antistatic</li> <li>• Touch screens</li> <li>• Organic TFT</li> <li>• Flexible LCDs</li> </ul>	
<b>Paste for LEDs</b>	<ul style="list-style-type: none"> <li>• Excellent thermal/electrical conductivity</li> <li>• Good dispensability and fillet formation</li> <li>• Low moisture absorption</li> </ul>	<ul style="list-style-type: none"> <li>• LED Chip Bonding</li> <li>• Conductive adhesive</li> </ul>	 <p>LED Chip Bonding Paste</p>

## CSC's Pastes for MTS

# MTS Paste Introduction

## ■ The Constitution of MTS



## ■ The Operating Principles of MTS

### ■ Separation of upper/lower printing circuits

■ When pressure is applied to the indicated area, the upper and lower circuits connect, allowing for signal transduction(change).

# MTS Paste Applications



Notebooks



Keyboards for Desktops



Key pads for Electronic toys



Key pads for electrical appliances





# MTS Pastes of CSC

## ■ For Desktops

	unit	Paron-910	Paron-910A	Paron-910B	Paron-910C	Paron-910D	Paron-910E	Paron-931	Paron-930	Paron-920
Application		Desktops							Desktops	
Composition		Ag							Ag/C	C
Halogen		Halogen							Halogen	
Curing Conditions		1 <sup>st</sup> IR oven 120 °C/2 min 2 <sup>nd</sup> Box oven 130 °C/30~60 min							1 <sup>st</sup> IR oven 120 °C/2 min 2 <sup>nd</sup> Box oven 130 °C/30~60 min	
Sheet Resistance	mΩ/sq./mi l	15.0 ± 1.0	20.0 ± 2.0	26.0 ± 2.0	31.00 ± 3.0	43.0 ± 4.0	75.0 ± 5.0	49.0 ± 4.0	28.0 ± 2.0	14000 ± 700
Volume Resistivity	μΩ·cm	37.5 ± 3.0	51.0 ± 5.0	65.0 ± 5.0	80.0 ± 7.0	110.0 ± 10.0	200 ± 20.0	125.0 ± 10.0	70.0 ± 6.0	35000 ± 1800
Line Resistance	Ω/5μm	270±20	370±30	480±30	580±40	800±50	1400±100	920±40	530±40	-
Adhesion Strength	-	100/100							100/100	100/100
Pencil Hardness	H	3							3	2

# MTS Pastes of CSC

## ■ For Desktops and Notebooks ; Halogen Free

	unit	Paron-960	Paron-960A	Paron-961	Paron-961A	Paron-961B	Paron-961C	Paron-961D	Paron-961E
Application		Notebooks		Desktops					
Composition		Ag		Ag					
Halogen		Halogen Free		Halogen Free					
Curing Conditions		1 <sup>st</sup> IR oven 120 °C/2 min 2 <sup>nd</sup> Box oven 140 °C/30~60 min		1 <sup>st</sup> IR oven 120 °C/2 min 2 <sup>nd</sup> Box oven 140 °C/30~60 min					
Sheet Resistance	mΩ/sq./mi l	10.7 ± 1.0	18.0 ± 2.0	15.0 ± 1.0	20.0 ± 2.0	26.0 ± 2.0	31.0 ± 3.0	43.0 ± 4.0	75.0 ± 5.0
Volume Resistivity	μΩ·cm	27.5 ± 2.0	50.0 ± 5.0	37.5 ± 3.0	51.0 ± 5.0	65.0 ± 5.0	80.0 ± 7.0	110.0 ± 10.0	200 ± 20.0
Line Resistance	Ω/5μm	200±20	280±20	270±20	370±30	480±30	580±40	800±50	1400±100
Adhesion Strength	-	100/100		100/100					
Pencil Hardness	H	3		3					

# MTS Pastes of CSC

## ■ For Low Curing Temperature

	unit	Paron-950	Paron-950A
Application		Desktops, Key pads for cell phones	
Composition		Ag	
Halogen		Halogen	
Curing Conditions		Box oven 80 °C/30~60 min	
Sheet Resistance	mΩ/sq./mil	16.0 ± 2.0	24.0 ± 2.0
Volume Resistivity	μΩ·cm	40.0 ± 4.0	70.0 ± 5.0
Line Resistance	Ω/5μm	300±30	450±40
Adhesion Strength	-	100/100	
Pencil Hardness	H	2	

## ■ For UV Curing

	unit	Paron-310	Paron-310T
Application		UV coating	
Composition		Polymer	
Halogen		Halogen Free	
Curing Conditions		300~600 mJ/cm <sup>2</sup>	500~1000 mJ/cm <sup>2</sup>
Sheet Resistance	mΩ/sq./mil	>10 <sup>13</sup>	>10 <sup>13</sup>
Adhesion Strength	-	100/100	100/100
Pencil Hardness	H	1	1

# Summary

## ■ Pastes for Desktops

- Various level of resistance (30 ~ 250  $\mu\Omega\cdot\text{cm}$ )
- Excellent adhesion strength for polyester film
- Good creasing characteristics

## ■ Pastes for Notebooks

- Excellent level of conductivity ( $27.5 \pm 2.0 \mu\Omega\cdot\text{cm}$ )
- Excellent creasing characteristics
- Excellent adhesion strength for polyester films

## ■ Pastes for Low Curing Temperature

- Excellent level of conductivity ( $40 \pm 4.0 \mu\Omega\cdot\text{cm}$ )
- Excellent adhesion strength for polyester film

## ■ UV Curable Pastes

- Excellent level of insulation resistance (  $>10^{13} \text{ m}\Omega/\text{sq./mil}$ )
- Excellent adhesion strength for polyester film
- Good compatibility for CSC paste



# Pastes for Touch Screen electrodes

# Introduction

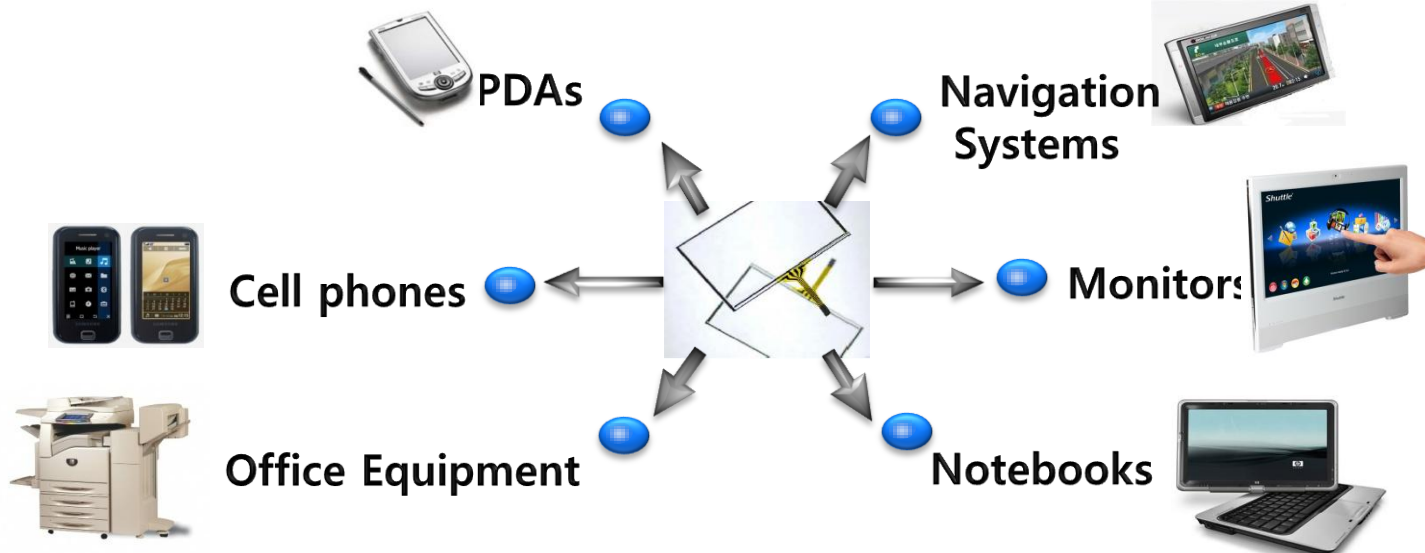
## 1. Touch Screens

- Input device : Touch (input) → Screen (output)
- Substitute for keyboards & mice
- Greater ease, More attractive



i-phone

## 2. Applications for Touch Screens



# Characteristics

## 1. Physical property & printing property

		Unit	Paron-810	Paron-810E	Paron-811	Paron-811A
Type of touch screen		-	Resistive type		Capacitive type	
Physical properties	Solid content	wt%	78 ± 2	70 ± 2	83 ± 2	80 ± 2
	F.O.G.	um	≤ 5	≤ 10	≤ 5	≤ 5
	Specific Gravity	-	2.7 ± 0.2	2.2 ± 0.2	3.1 ± 0.2	2.9 ± 0.2
	Viscosity *	Poise	250 ± 50	250 ± 50	1,000 ± 50	800 ± 50
Printing properties	Volume Resistivity	10 <sup>-6</sup> Ω·cm	≤ 80	≤ 200	≤ 80	≤ 80
	Pencil Hardness	H	2	2	2	2
	Adhesion Strength (PET & ITO electrode)	-	100/100	100/100	100/100	100/100
	Fine Line Resolution	um	100	200	50	70

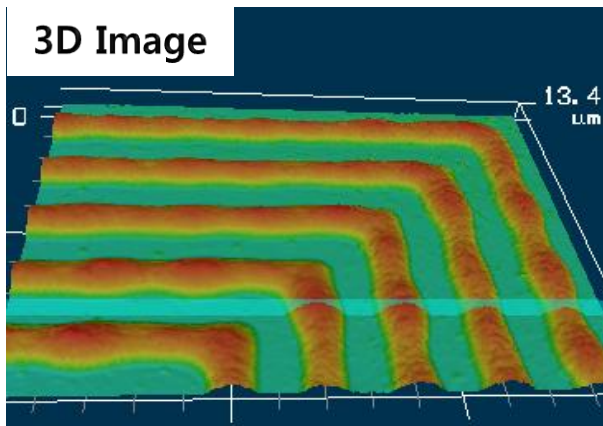
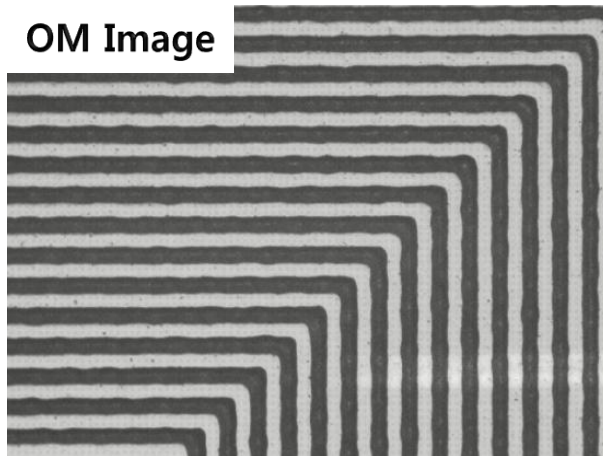
\* Viscosity : Brookfield HB DVII+, spiendle #14, 50rpm @25°C



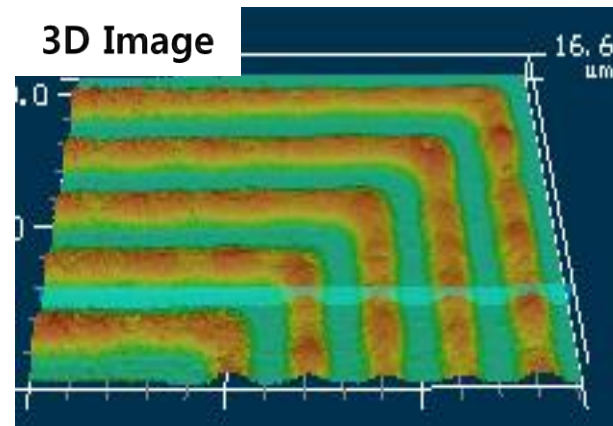
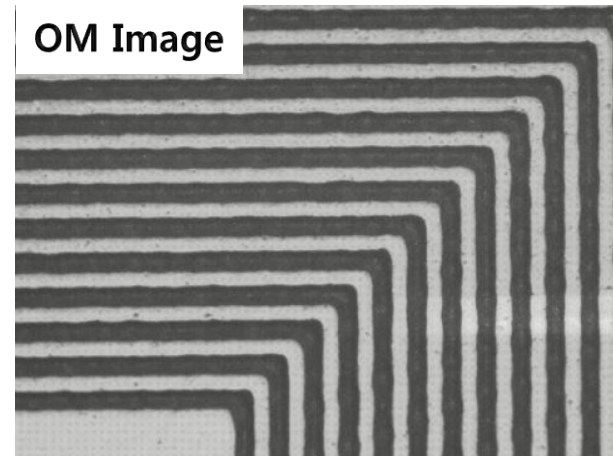
# Characteristics

## 2. Fine line resolution

Paron-811 (Line width : 50  $\mu\text{m}$ )



Paron-811A (Line width : 70  $\mu\text{m}$ )





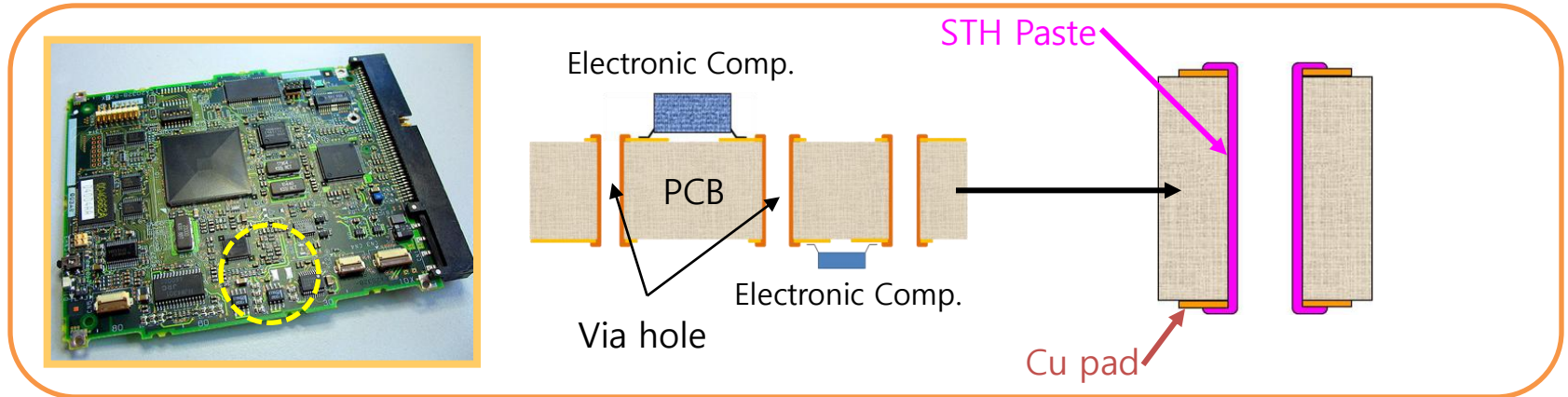
# Summary

1. This product has very good printing characteristics due to uniform dispersion of inorganic powders in the organic binders.
2. The structure of cured paste provides excellent adhesion to ITO electrodes, high level of conductivity and low contact resistance in ITO electrodes.
3. The unique feature of this paste is its fine line resolutions.

# CSC's Pastes for PCB Through Holes

# Product Introduction

- Used for double-sided printed circuit boards (PCB)
- To make electronic connections of both sides of the circuit through holes



## ▪ Advantages

1. High level of conductivity and reliability
2. Controlled rheological property  
(No defects such as pinholes or cracks)
3. Good adhesion to Cu plates and PCBs
4. Depressed silver migration

## ▪ Applications

- TVs, remote controls
- Computers, fax machines
- CD-ROMs and DVD-ROM drives
- Car navigation systems, Car stereos

# Characteristics

## 1. Properties

Test Item	Specification	Remark
Non-volatile content (N/V)	73.0±2.0	-
Specific gravity	2.3±0.2 g/cc	-
Viscosity	60±10 poise	Rion VT-04 #1 spindle @23°C
Thixotropic index	-	-
Fineness of grind	< 10	-
Resistance/hole	<100 mΩ/hole	-
Pencil hardness	≥ 4H	-
Cross-hatch cut	100/100	-
Soldering test	-100% ~ 20%	Resistance change ratio
Hot oil test	-100% ~ 20%	Resistance change ratio



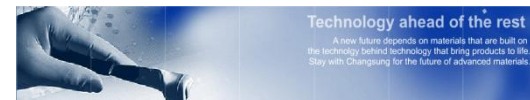
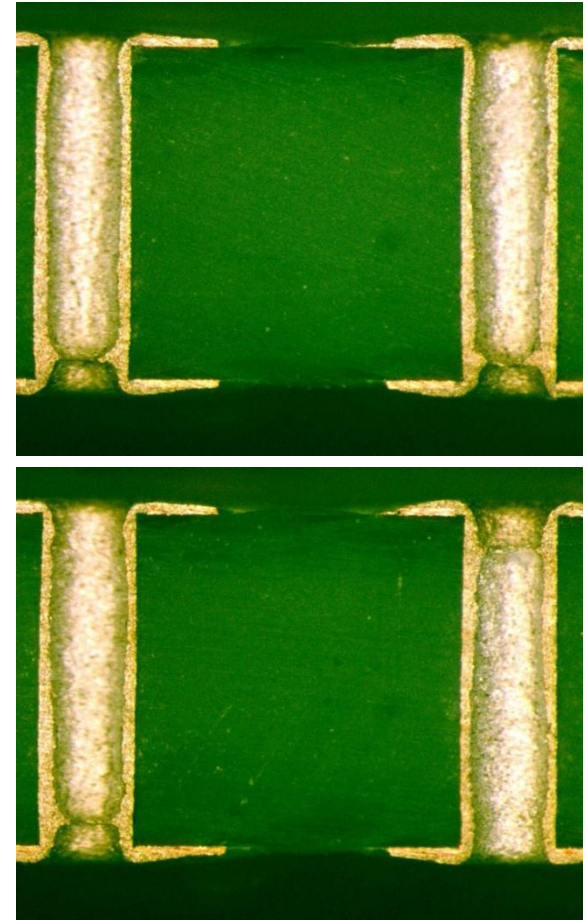
# Characteristics

## 2. Soldering Test

- 1) Soldering Test Method
  - Solder Pot/ 260°C/5 sec /5 times
- 2) Soldering Test Results

	Paron-621
Resistance Before Solder Test (mΩ/Hole)	33.74
	34.20
	33.03
Average	<b>33.66</b>
Resistance After Solder Test (mΩ/Hole)	33.26
	33.18
	32.58
Average	<b>33.01</b>
Change Ratio(%)	<b>-1.93</b>

※ Diameter of Test Specimen : FR-1  $\Phi$  0.45mm



# Characteristics

## 3. Hot Oil Test

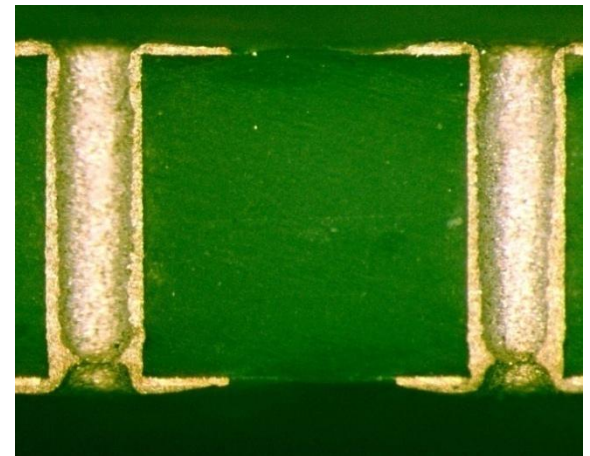
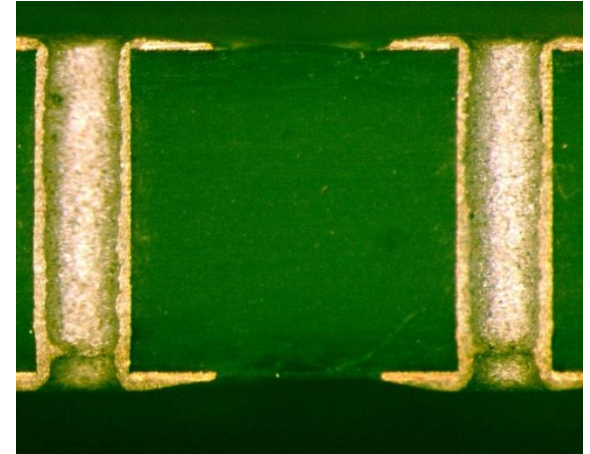
### 1) Hot Oil Test Method

- [Silicon Oil/Room Temp./5 sec ↔ Air/5 sec  
↔ Silicon Oil /260°C/5 sec] / 100 cycle

### 2) Hot Oil Test Results

	Paron-621
Resistance Before Hot Oil Test (mΩ/Hole)	33.54
	33.98
	34.02
Average	<b>33.85</b>
Resistance After Hot Oil Test (mΩ/Hole)	32.65
	32.14
	32.01
Average	<b>32.27</b>
Change Ratio(%)	<b>-4.67</b>

※ Diameter of Test Specimen : FR-1 Φ 0.45mm



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# Summary

## ▪ Paron-600 Series :

Conductive Paste for double-sided printed circuit boards (PCB)

- High level of conductivity and reliability
- Controlled rheological property
- Good adhesion to Cu plate and PCB
- Depressed silver migration

# CSC's Pastes for FPCBs

# Product Introduction

## ▪ Description

This product is designed as a screen printing conductive paste for flexible printed circuitry.

## ▪ Substrate : polyimide film

## ▪ Basic Properties

1. High level of conductivity
2. Excellent adhesion to polyimide film
3. Excellent level of flexibility
4. Excellent level of thermo-stability
5. Good printability

# Product Introduction

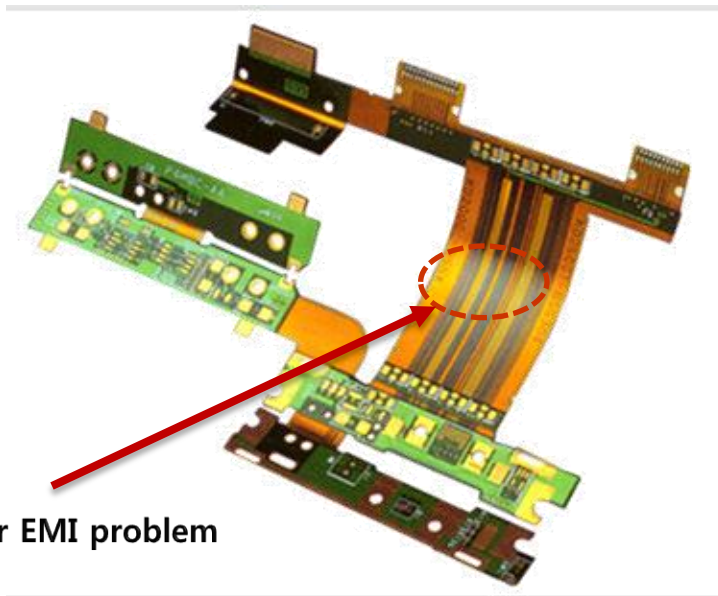
## ▪ Applications

Mobile Phones, Cameras

Computers, LCDs

CD-ROM drives and DVD-ROM drives

Military instruments, medical devices



Paste for EMI problem



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# Characteristics

## 1. Properties

Test Item	Specification	Remark
Non volatile content(N/V)	70.0±2.0	-
Specific gravity	2.1±0.2	-
Viscosity	250±50	Rion VT-04 #1 spindle @23°C
Thixotropic index	-	-
Fineness of grind	<10	-
Sheet resistivity	<200 mΩ/□/10um	-
Line resistance	< 500 Ω/10um (400μm × 1480mm)	-
Pencil hardness	≥ 4H	-
Cross-hatch cut	100/100	-

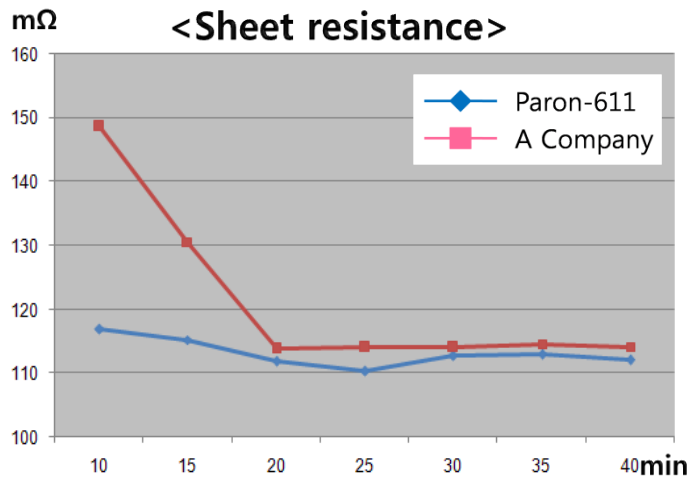


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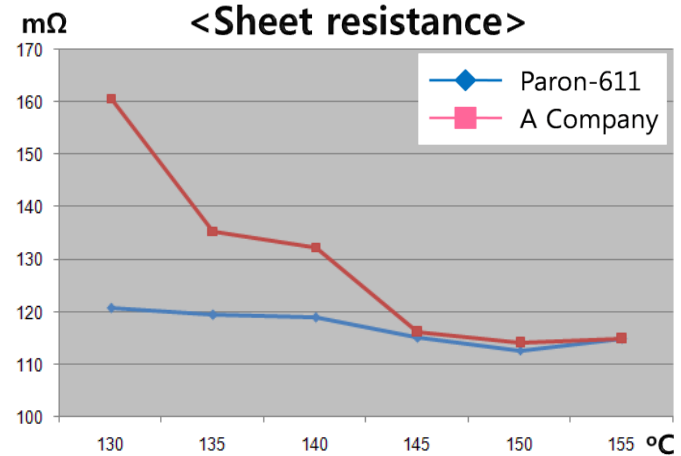
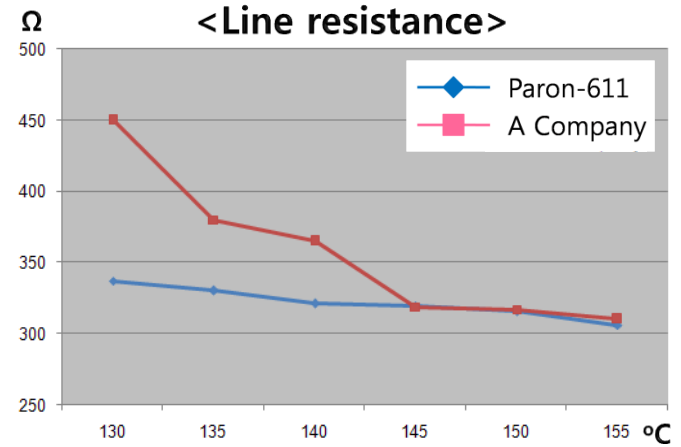
# Characteristics

## 2. Electrical Properties

Resistance of various curing times at a fixed temperature, 150°C



Resistance of various curing temperatures at a fixed curing time, 30min



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# Summary

## ▪ Paron-611 :

Conductive Paste for flexible printed circuitry (FPCB)

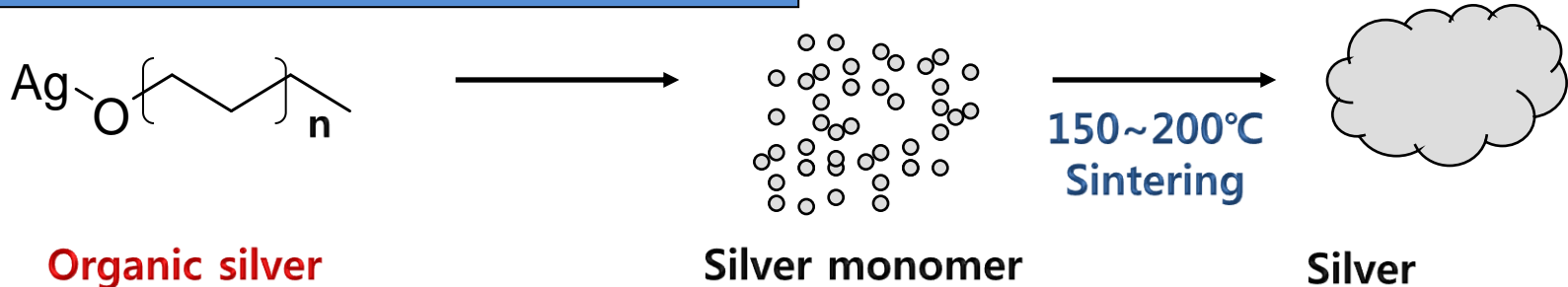
- Good printing characteristics
- High level of conductivity and good wear resistance characteristics
- Low level of resistivity and fine line resolution
- Excellent adhesion to polyimide film and copper plates
- Excellent flexibility

# Low Temperature Sintering Silver Nano Pastes

# Product Introduction

## Low temperature sintering mechanism

### Metallo-organic decomposition -CSC



## CSC'S New Conductive Pastes

- Functional phase : main functional properties
- Binder : adhesion strength to the substrate (if needed)
- Catalyst : catalyst for sintering at low temperatures

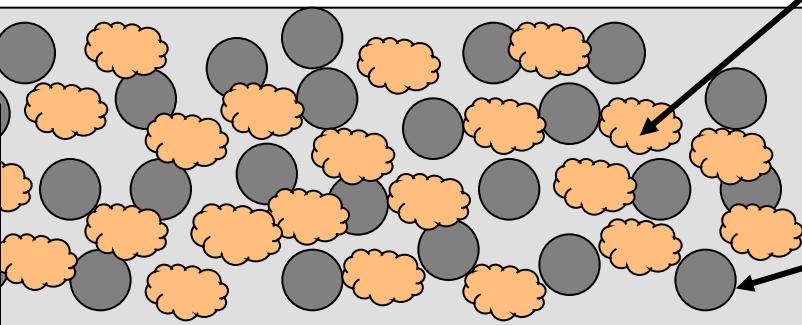
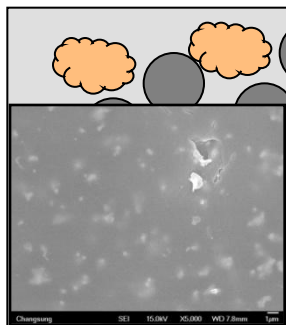
## Silver nano pastes

- low viscosity paste **using MOD solution** (for ink jetting process)
- High viscosity paste **using MOD compound and powder** (for screen printing process)

# Characteristics

## Conductive Silver Paste using MOD

As printed

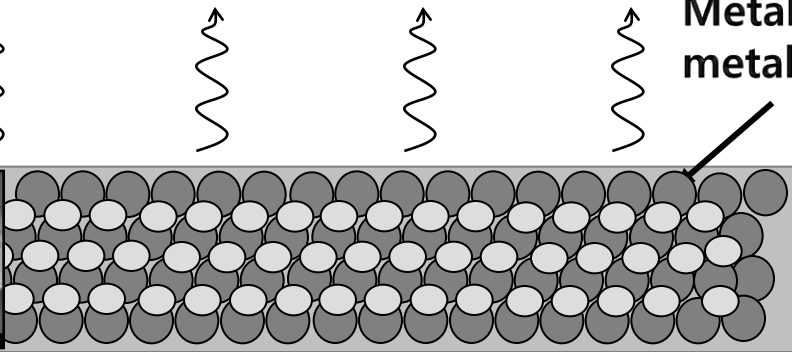
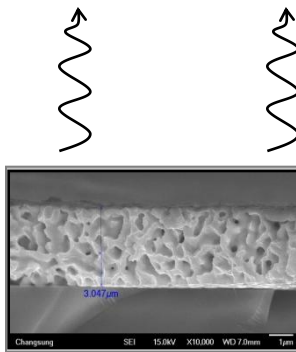


Reactive Metal Organic  
(500~700nm)

Silver filler  
(~200nm)

~0.2 million cp @1rpm

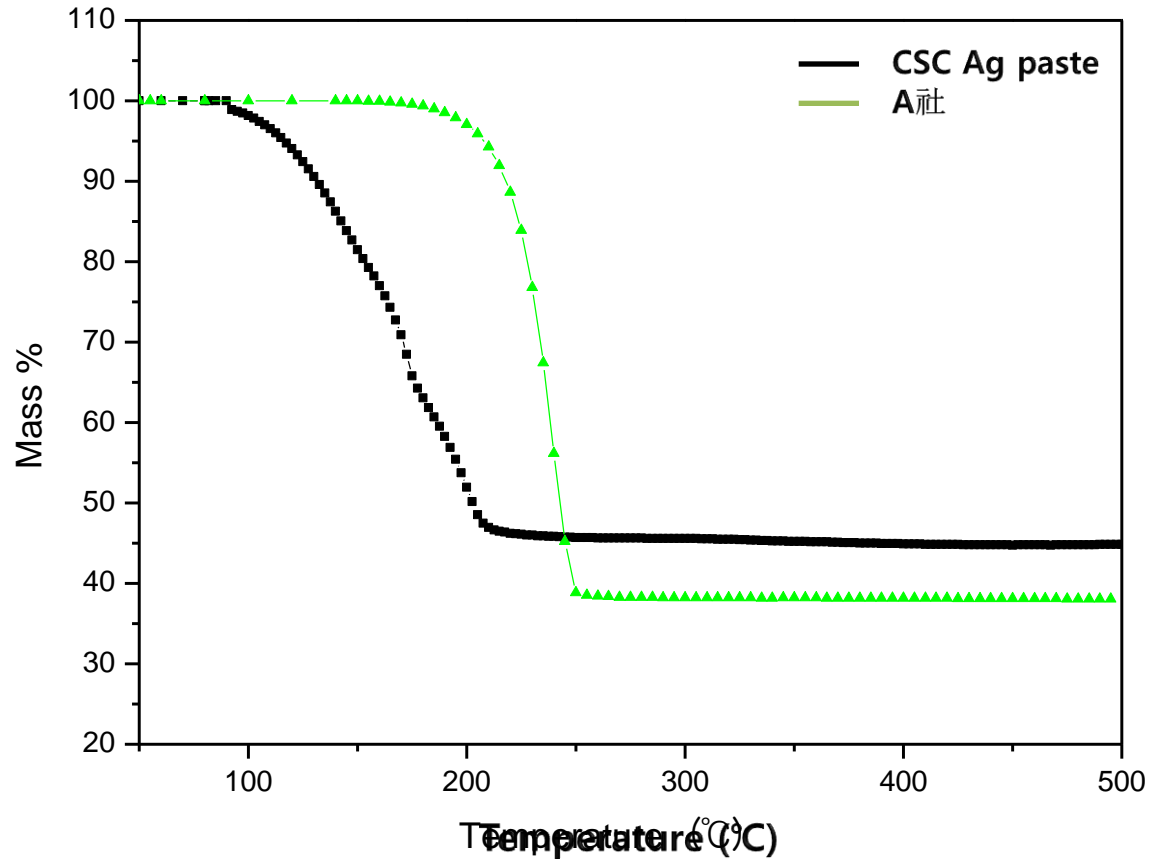
As cured



Metallo-organic welds  
metal particles together

# Characteristics

## TGA Analysis of Conductive Paste



### TGA analysis condition of conductive paste

- Instrument : **Netzsch STA 449C**
- Range : **25 ~ 600°C**
- Condition : **5.0K/min, air**



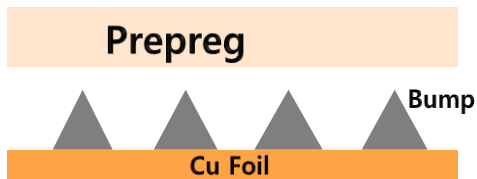


# Characteristics

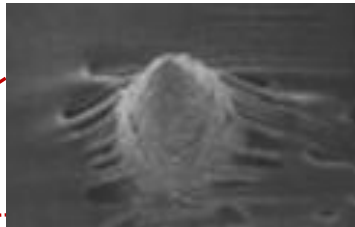
## Application for Buried Bump Interconnection Process

### B<sup>2</sup>it process

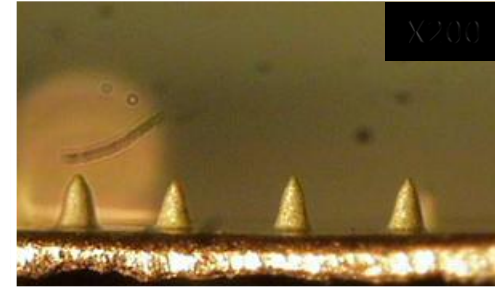
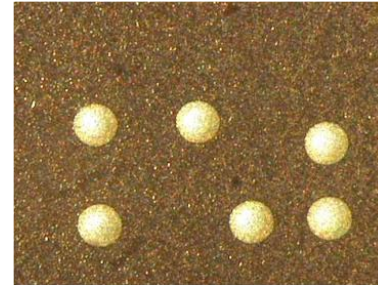
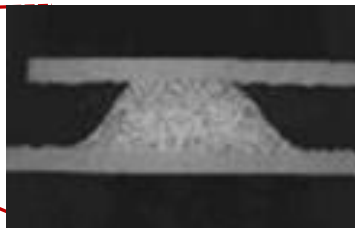
#### Printing



#### Piercing



#### Lamination

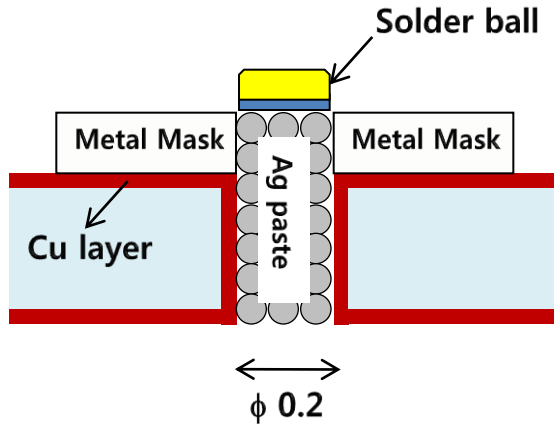


Height(μm)	< 120 ~ 130	Sintering temperature (°C)	130 ~ 170
Width(μm)	< 160 ~ 170	Sintering time (min)	less than 60 min
Shape of bump	Sharp	Substrate	Cu-foil

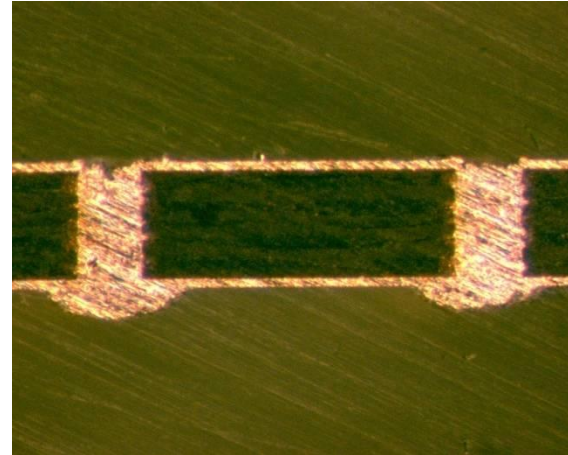
- Control ratio of powder
  - Shape of bumps
  - Various heights and widths of bumps
- Suitable for B<sup>2</sup>it process
  - Height and Sharpness of bumps
- Low Sintering Temperature
  - Because of the low-curing temperature, it's possible to apply other substrates such as glass as well as PET, PI films etc.

# Characteristics

## Application for Hole Plugging

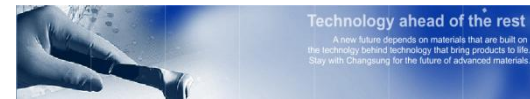


Hole Plugging Structure



### : Low Temperature Sintering Pastes

- Low temperature applications ( $\leq 180^{\circ}\text{C}$ )
- Using Ag coated copper powders as metal fillers
- Excellent chemical stability
- Good hole plugging
- Low cost compared with silver
- Screen printing process

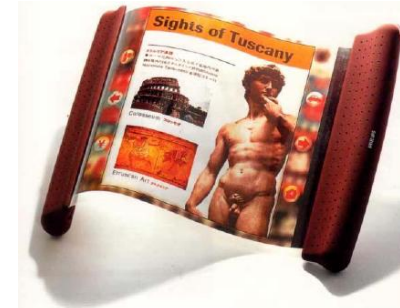


# Characteristics

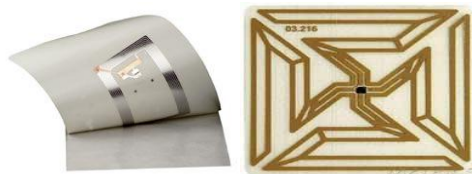
## Application of low temperature sintering materials

### Flexible Printed Circuit Boards

#### Flexible displays



e-books



RFID antennas

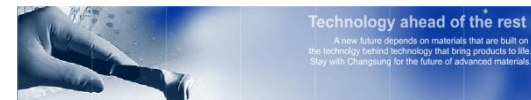
*LTS series*



Flat displays



Solar cells



Technology ahead of the rest  
A new future depends on materials that are built on  
the technology behind technology that brings products to life.  
Stay with Changsung for the future of advanced materials.

# Summary

- Nano sized particles can be sintered at low temperatures (150°C ~ 200°C)
- Optimum composition for screen printing
- Show bulk-like sintered structure
- High level of conductivity (  $< 5\mu\Omega\cdot\text{cm}$  )
- Good adhesion to a variety of substrates
- High level of stability and long-term storage capability

# Inner Pastes for Chip Inductors

(Ag 85%, 88%, 90%)

# Product Introduction

## 1) Specifications

Item	Unit	Ag 85%	Ag 88%	Ag 90%
Solid Content	wt%	85.0 ± 2.0	88.0 ± 2.0	90.0 ± 2.0
Viscosity*	cps	180,000 ± 20,000	210,000 ± 20,000	200,000 ± 20,000
T.I.**	-	2.2 ± 0.4	3.0 ± 0.5	3.5 ± 0.5
F.O.G.	μm	≤ 5	≤ 7	≤ 7
Specific Gravity	g/cc	4.2 ± 0.2	4.7 ± 0.2	5.1 ± 0.2

\* Viscometer : Brookfield SSA 14/6R (10 rpm) @ 25°C

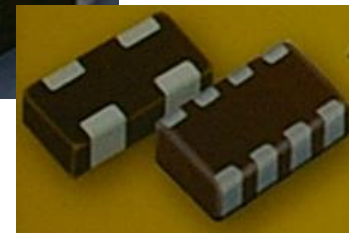
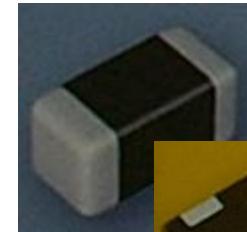
\*\* T.I. (Thixotropic Index) : viscosity @ 10 rpm/viscosity @ 100 rpm

### Main Features

- excellent conductivity with good printing rheology
- Low Rdc
- Excellent line resolution

### Applications

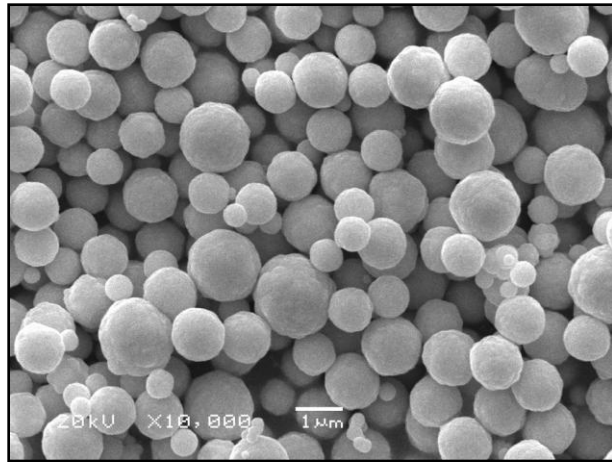
- Multilayer inductors
- Power inductors
- Chip beads
- Common mode filters



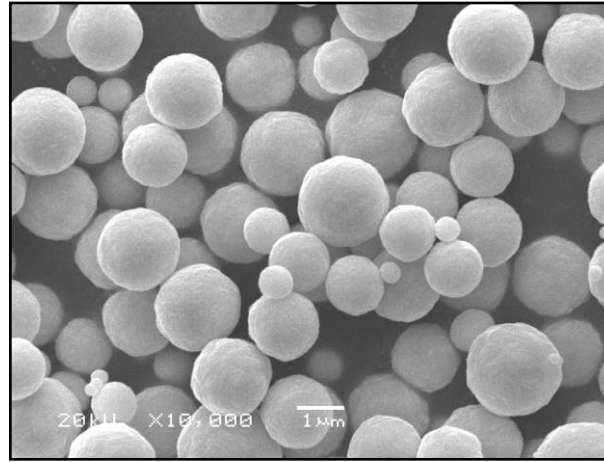


# Characteristics of Ag Powders

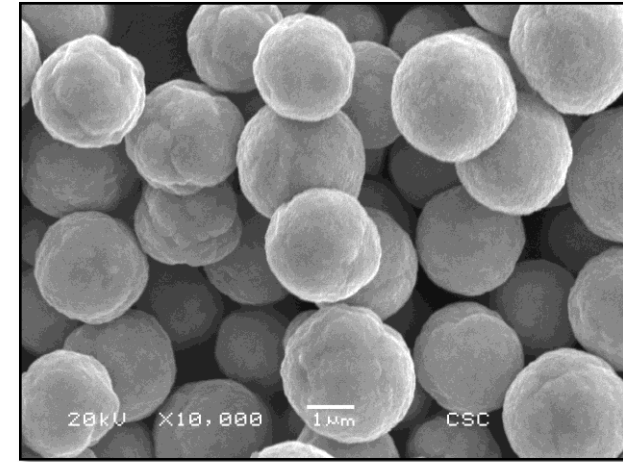
## 1) Powder types



**A**



**B**



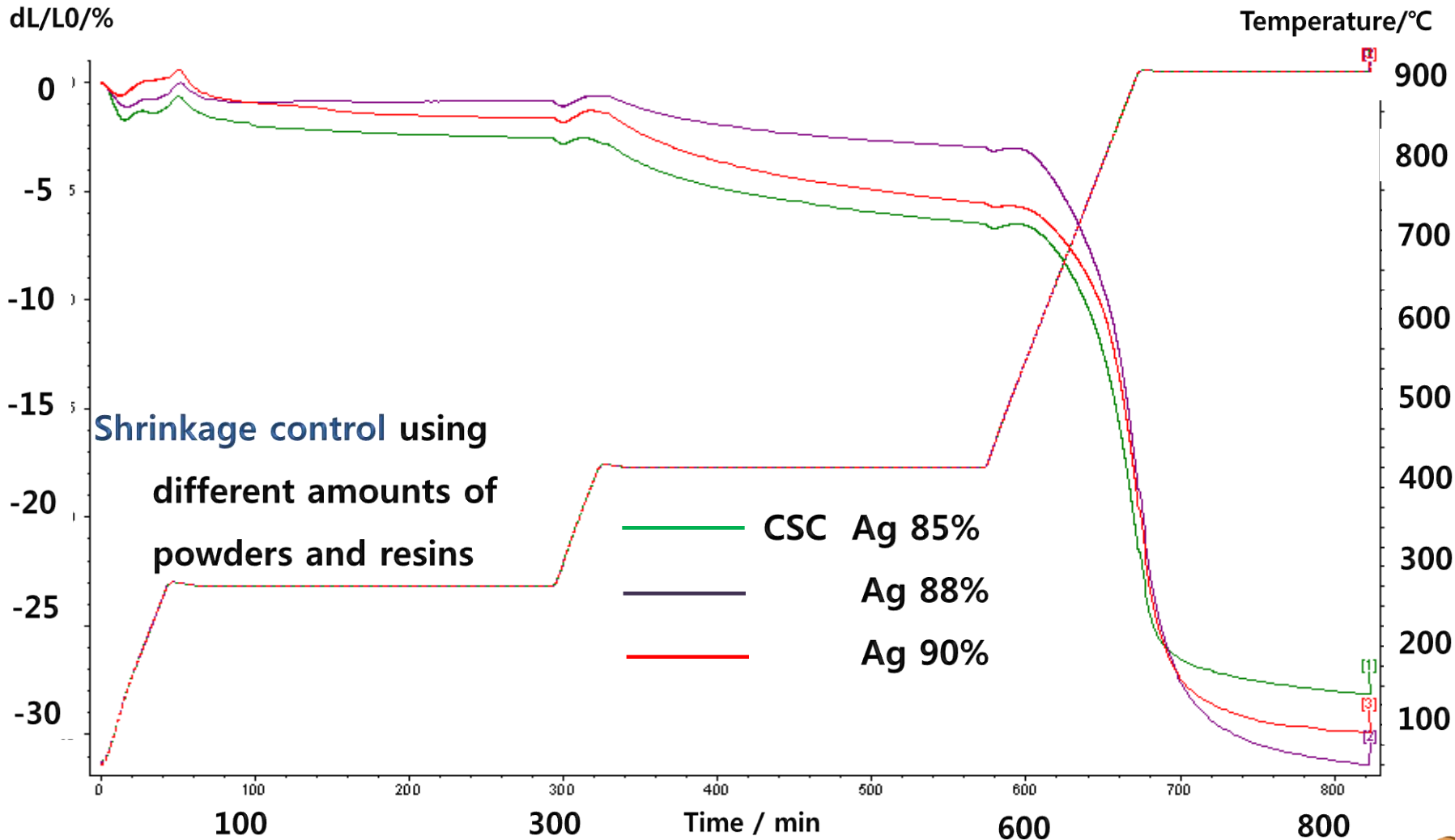
**C**

Ag Powder	AD (cc/g)	TD (cc/g)	Laser particle size analyzer(μm)			BET (m <sup>2</sup> /g)	C (wt%)	O (wt%)
			D <sub>10</sub>	D <sub>50</sub>	D <sub>90</sub>			
A	2.21	3.71	0.72	1.09	1.82	0.85	0.11	0.09
B	2.59	4.10	1.09	1.56	3.04	0.70	0.06	0.05
C	2.80	4.20	1.83	2.70	4.85	0.66	0.05	0.15



# Characteristics of Ag Powder

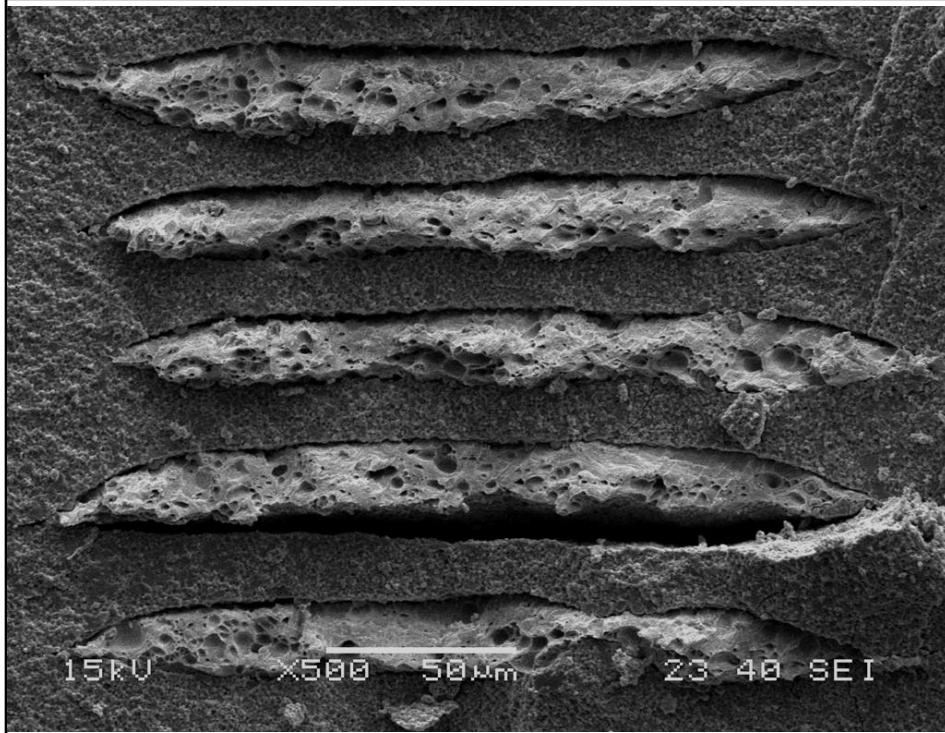
## 2) Shrinkage of paste



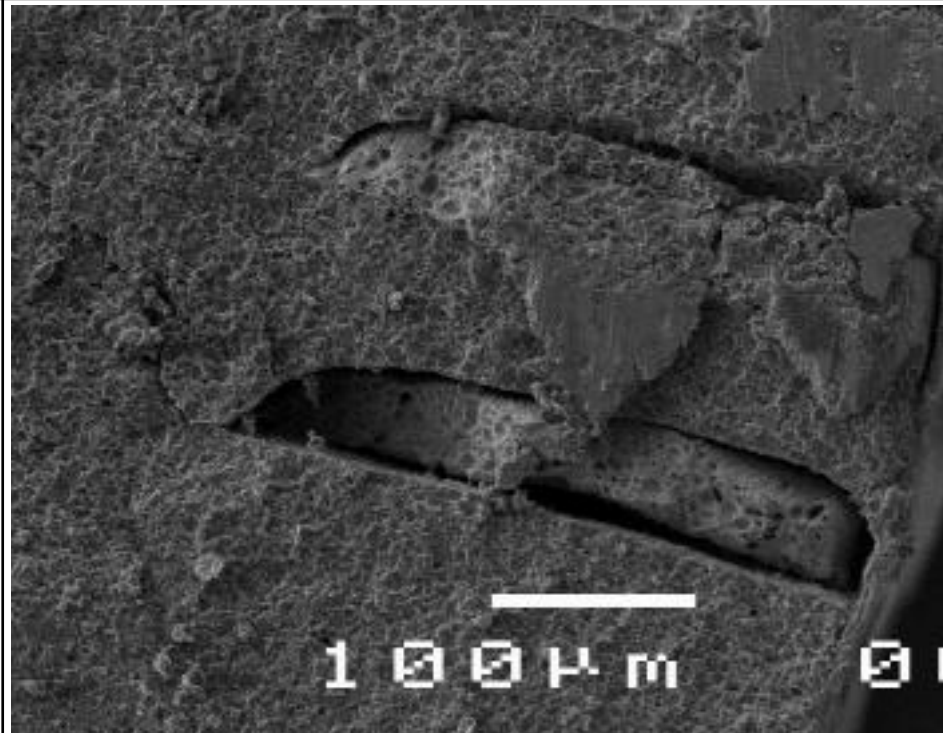
# Characteristics of Ag Powder

## 3) Matching Properties with Ferrite Sheets

Chip cross section - A



Chip cross section - B



Interface gap formation

→ Low residual stress

# Characteristics of Ag Powders

900°C/1hr	Ag 85%	Ag 88%	Ag 90%
Surface (x1000)			
Cross-Section (x1000)			
Line resistance	5.96Ω	4.87Ω	4.13Ω
Volume resistance	2.78uΩ · cm	2.34uΩ · cm	2.19 uΩ · cm

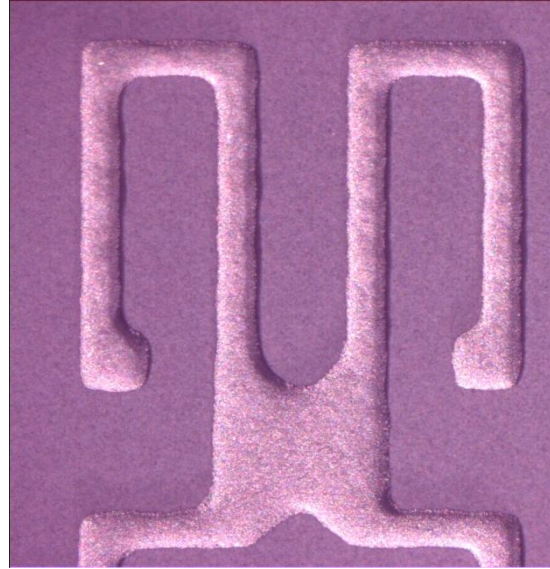


# Printing

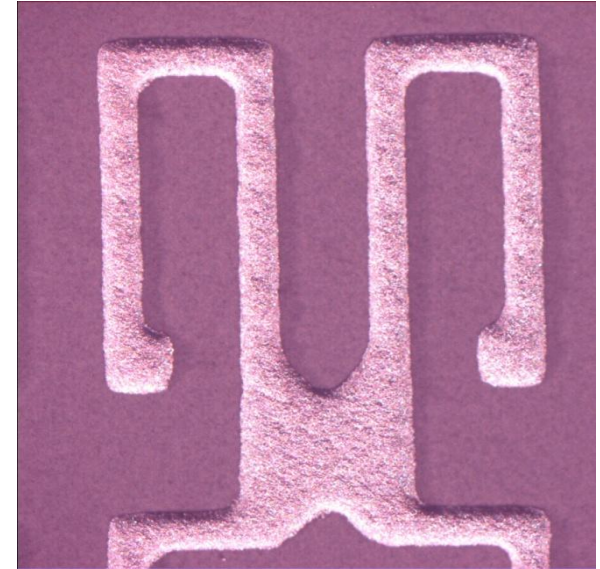
## 1) Line resolution



Speed – 40mm/sec  
Pressure – 0.18Mpa



CSC – Ag90% (70times)

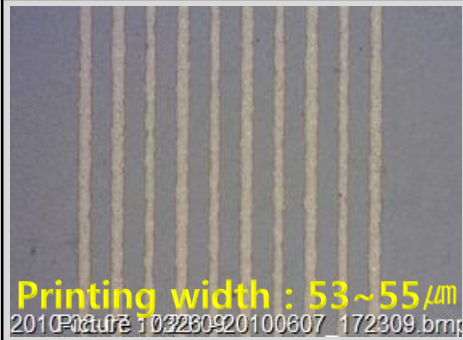


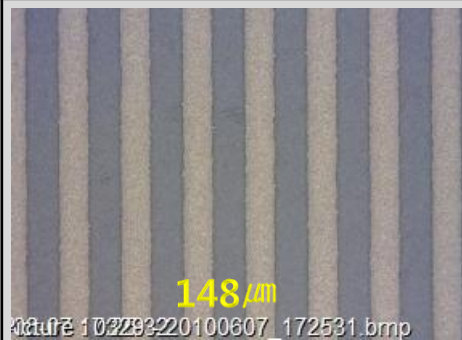


N社 – Ag90% (70times)

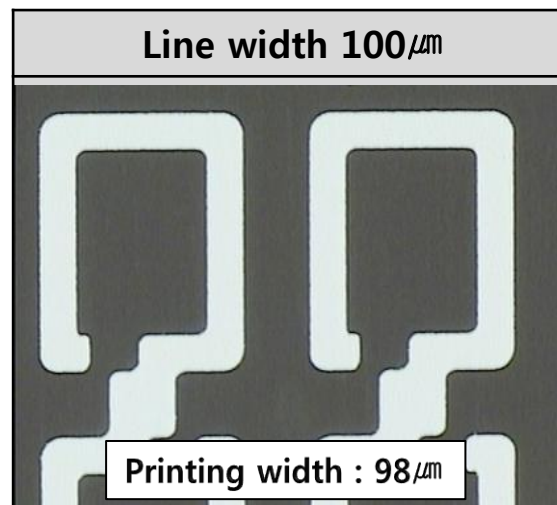
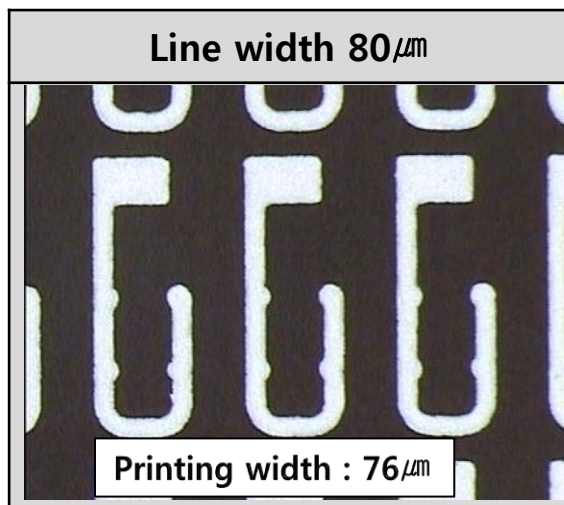
	Line width (Spec.:100~120 $\mu$ m)										
	1th	2th	3th	..	45th	46th	..	68th	69th	70th	A.V.E.
CSC	113.5	114.4	113.1	..	111.7	112.2	..	113.2	112.6	112.6	112.7
N社	111.4	115.4	114.5	..	113.3	112.9	..	114.2	113.7	113.8	113.9

# Printing

## 2) Printing quality (Ag90%) - I

Line width 60 $\mu$ m Line distance 60 $\mu$ m	60 $\mu$ m / 150 $\mu$ m	100 $\mu$ m / 150 $\mu$ m	150 $\mu$ m / 150 $\mu$ m
 <p>Printing width : 53~55<math>\mu</math>m</p> <p>2010-10-17 10:22:30-20100607_172309.bmp</p>	 <p>58<math>\mu</math>m</p> <p>010-10-17 10:22:27-20100607_172417.bmp</p>	 <p>97<math>\mu</math>m</p> <p>010-10-17 10:22:30-20100607_172503.bmp</p>	 <p>148<math>\mu</math>m</p> <p>010-10-17 10:22:32-20100607_172531.bmp</p>



## 3) Printing quality - II



# Inspection Methods

## 1) Sheet attack (Leave 5 minutes after printing)



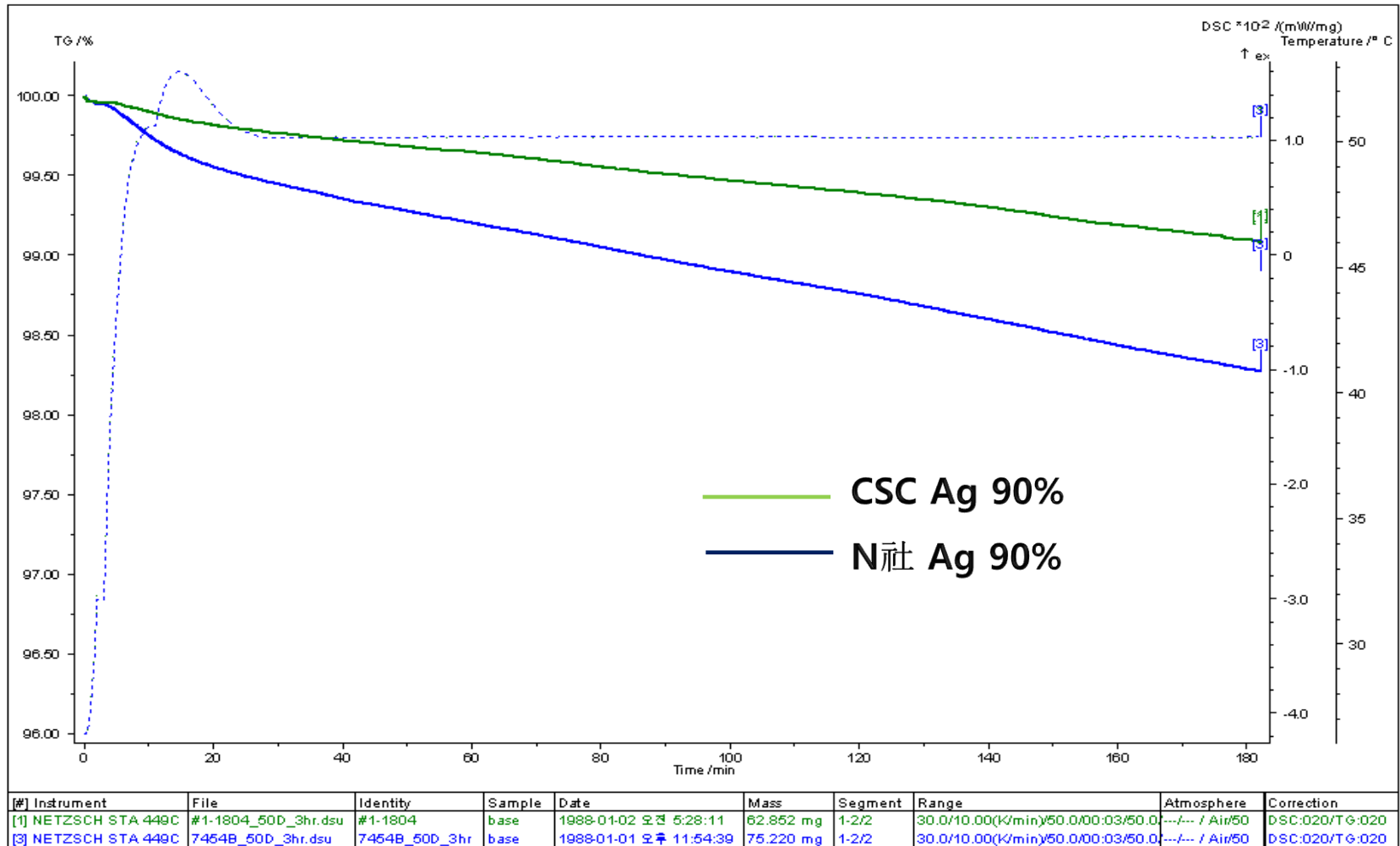
Attack	Non attack
	

## 2) Viscosity Stability

		Production	After 2 days	After 9 days
Ag 90%	10rpm	212,000	214,000	211,000
	T.I. (1/10)	3.63	3.50	3.55

# Inspection Methods

## 3) Dry speed of paste - *Low Drying*





# Summary

- Excellent conductivity with suitable printing rheology
- **Excellent line resolution**
- **Low Rdc**
- **Low residual stress**
- Low sheet attack
- Slow solvent drying speed

# CSC's Pastes for Chip Varistors

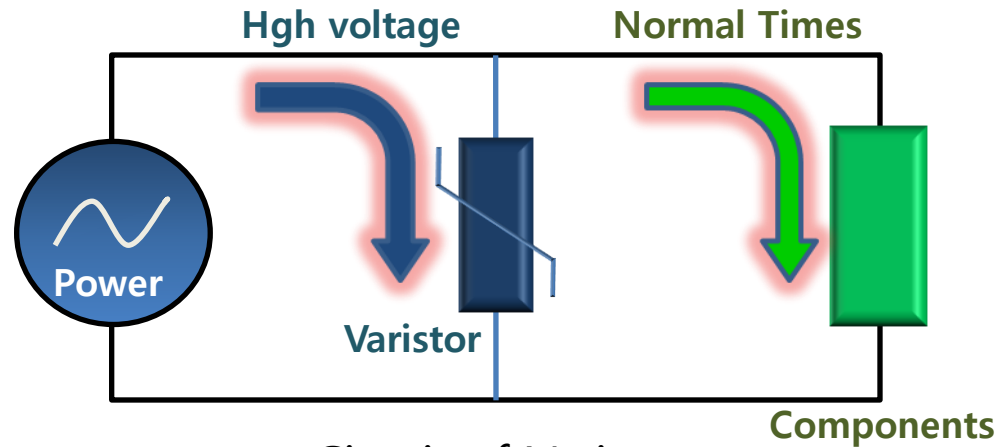
Inner Electrodes : CSP-0230, CSP-0220

Terminal Electrodes : Paron-L65

# Product Introduction

## ◆ Chip Varistors ?

1. Varistors : Variable Resistors, VDR(Voltage Dependent Resistors)
2. Protection of cellular phones, PDAs, High Speed Data Lines...etc.
3. ESD Protection for components sensitive to IEC 61000-4-2, Provides Circuit Board Transient Voltage Protection for Transistors.



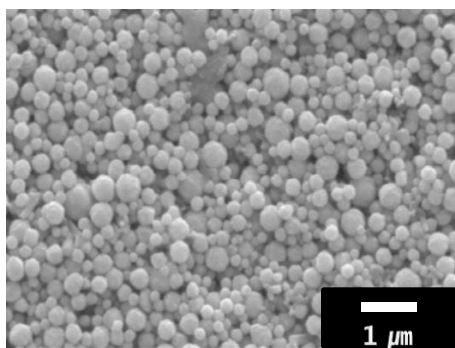
<Circuit of Varistor>

	Product No.	Filler	Sintering condition	Comments
<p>Paron-L65</p> <p>CSP-0230, 0220</p>	CSP-0230	Ag/Pd=7/3	950~1150°C	- Electrical property control
	CSP-0220	Ag/Pd=8/2	900~1050°C	-Electrical property control - Low cost
	Paron-L65	Ag	600~700°C	-Excellent solderability -Strong adhesion strength

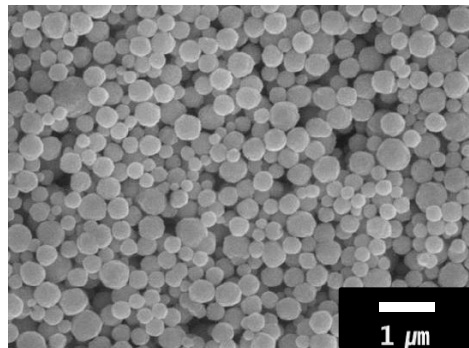
# Test Results – Inner Electrodes

## ◆ Ag/Pd Inner Electrode properties

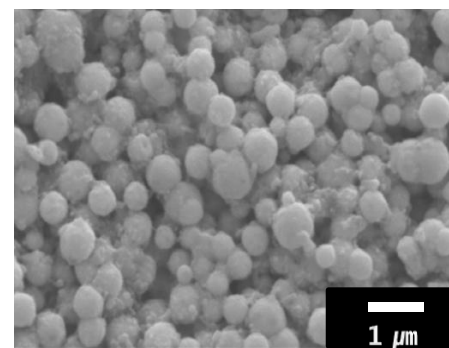
Maker		CSC	CSC	A	B
		CSP-0230	CSP-0220		
Metal		Ag:Pd=7:3	Ag:Pd=8:2	Ag:Pd=7:3	Ag:Pd=7:3
Solid Content(%)		56%	60%	50, 57%	56%
Viscosity (cps)	1rpm	60,000	80,000	40,000	30,000
	10rpm	32,000	34,000	25,000	24,000
	100rpm	18,000	18,600	15,000	14,300
T.I. (10/100rpm)		1.78	1.83	1.67	1.68
FOG		2.0	2.0	2.0	2.0



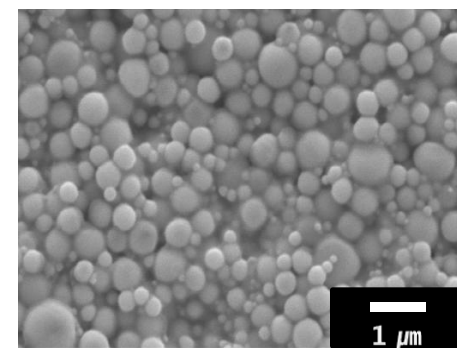
CSC : CSP-0230



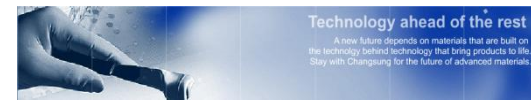
CSC : CSP-0220



A



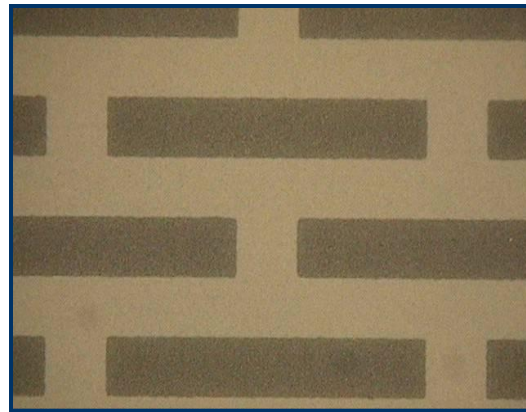
B



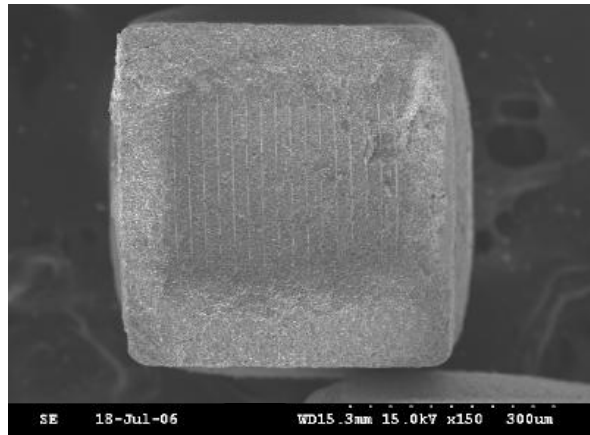
# Test Results – Inner Electrodes

- ◆ Ag/Pd Inner Electrode properties III
  - Printing quality & Cross-sectional Microstructure

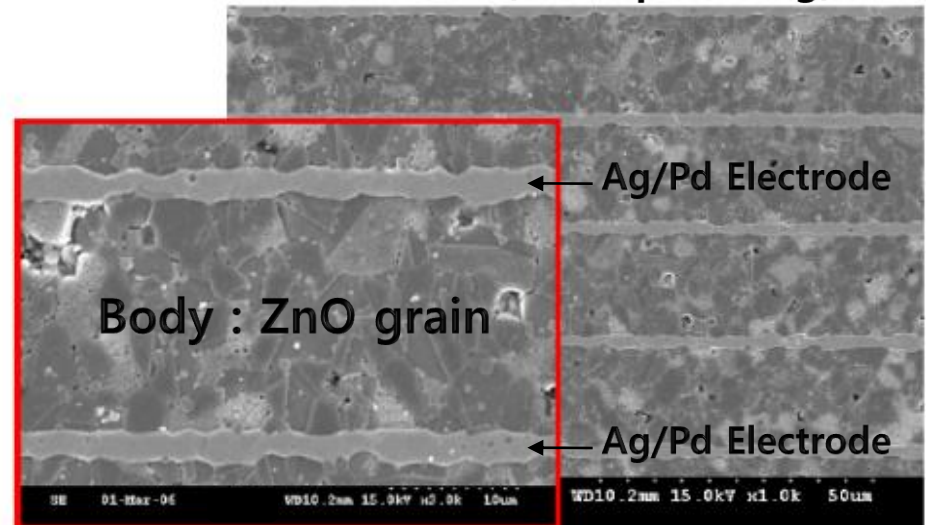
Printing Image



Cross sectional view of cutting chips



Cross sectional view (After polishing)



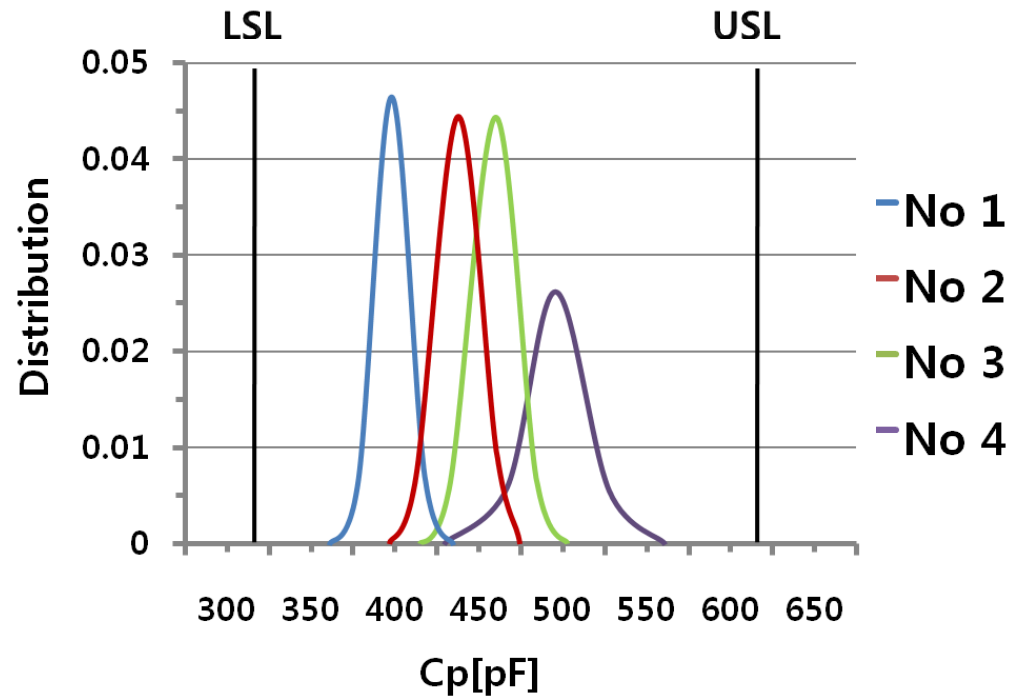
# Test Results – Inner Electrodes

## ◆ Ag/Pd Inner Paste properties V

- Electrical properties

◆  $C_p$  can be adjustable with the same metal contents

No.	$V_n$ [V]	$C_p$ [pF]
Spec.	6.8-9.6	336-624
1	8.32	395
2	8.34	438
3	8.39	461
4	8.35	493





# Test Results – Terminal Electrodes

## ◆ Ag Termination Electrode Properties I

- Typical Characteristics

Grade		Metal Content (%)	Solid Content (%)	Viscosity* (Pa·s)	T.I.*	FOG*** (μm)	Specific Gravity (g/cc)
Paron-L65	Spec.	59%	70±2	45±10	1.8±0.5	≤ 7.0	2.5±0.3
	Meas.		69.64	48	2.0	4.0	3.3

\* Viscometer : Brookfield SSA 14/6R (10 rpm) @ 25°C

\*\* T.I. (Thixotropic Index) : viscosity @ 10 rpm/viscosity @ 100 rpm

\*\*\* FOG (Fineness of Grind) : 50% scratch point

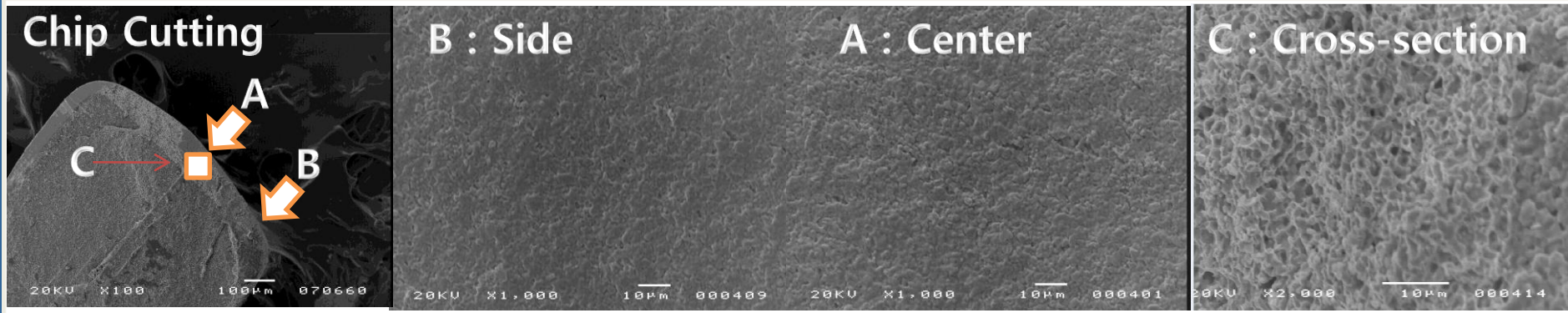
# Test Results – Terminal Electrodes

## ◆Ag Termination Electrode Properties II

-Printing quality & Cross-sectional Microstructure



✓600°C/10min firing



# Test Results – Terminal Electrodes

## ◆ Ag Termination Paste Properties III

- Electrical properties

### Electrical Properties & Reliability Test

	Before					After THB (Temp/Humidity with Bias Test)						
Property	Breakdown Voltage (Vn@1mA)		Leakage Current (IL@Vdc)		Insulation Resistance (MΩ@3.6V)	Breakdown Voltage (Vn@1mA)		ΔBreakdown Voltage		Leakage Current (IL@Vdc)		Insulation Resistance (MΩ@3.6V)
Direction	+	-	+	-		+	-	+	-	+	-	
SPEC.	24 ~ 32 V		20μA ↓		10MΩ↑	24 ~ 32 V		10% ↓		20μA ↓		10MΩ↑
A.v.g.	26.88	27.32	0.073	0.054	15.863	26.89	27.40	0.04	0.26	0.089	0.103	31.673

### Tensile Strength

Chip Size	0402	0603
Spec.	0.8kgf ↑	1.6kgf ↑
Result	1.4 ~ 2.4kgf	2.1~ 4.8kgf



Technology ahead of the rest  
 A new future depends on materials that are built on  
 the technology behind technology that brings products to life.  
 Stay with Changsung for the future of advanced materials.

# Summary

## ◆ Inner Electrodes

Competitive price

Cp can be adjustable with the same metal content

Good Thermal compatibility with substrate

High electric conductivity : Low electric resistance

Thin layer structure allowed: Film thickness of 1.5  $\mu\text{m}$  or less

Printing characteristics : easy to use, good line resolution

## ◆ Terminal Electrodes

Good adhesion

Good thermal match to ceramic body

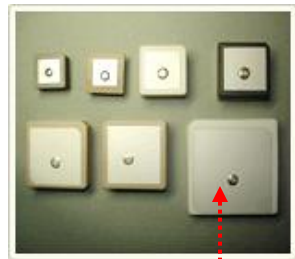
Dense microstructure : Excellent plating characteristics

# CSC's Paste for Antennas & Piezos

# Product Introduction - Antennas

## ■ Ceramic Antennas for GPS/DMB or Mobile phones

### 1) GPS Patch Antennas



Ag paste



Antenna Modules

### 2) Dielectric Chip Antennas



Ag paste



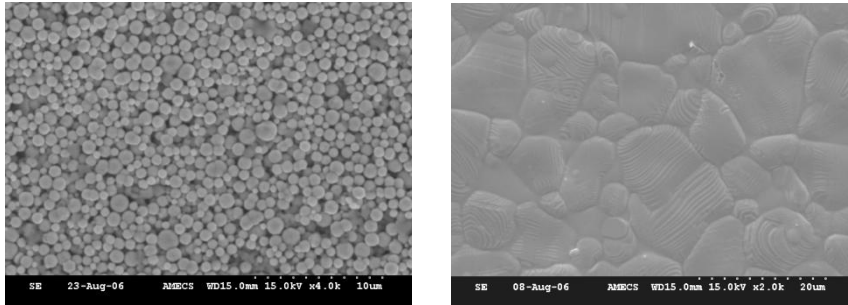
Intennas

Product No.	Application	Filler	Application method	Sintering condition
CSP-1381	GPS Patch Antennas	Ag 80%	Screen printing	800~890°C
CSP-1381E		Ag 50%	Screen printing	800~890°C
CSP-1381A	Dielectric Chip Antennas	Ag 80%	Screen printing	830~880°C



# Characteristics - Antennas

## 1) GPS Patch Antennas

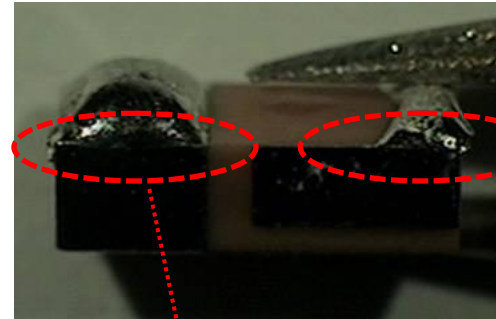


< Sinter: 850°C/10min >

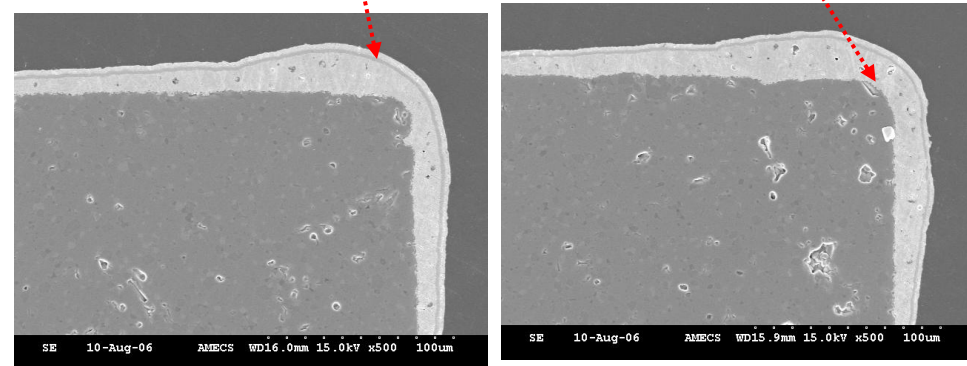
\* Adhesion strength (spec. 6.5 kgf/min)

No.	Competitor	CSC
1	13.07	15.37
2	12.42	18.99
3	16.86	15.65
4	11.61	18.76
5	18.87	16.80
6	10.08	13.11
7	9.42	14.67
8	15.40	14.78
9	13.34	15.86
10	17.67	15.94
<b>AVG</b>	<b>13.87</b>	<b>15.99</b>
<b>MAX</b>	<b>18.87</b>	<b>18.99</b>
<b>MIN</b>	<b>9.42</b>	<b>13.11</b>

## 2) Dielectric Chip Antennas



< Solder Leaching resistance test. >



< Non Leaching >



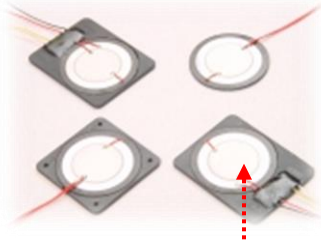


# Summary -

- Good thermal compatibility with substrates
- Smooth and even surfacing with gloss after main firing
- Excellent dispersibility and electrode continuity
- **Excellent adhesion and leaching resistance**
- Dense microstructure
- Firing shrinkage curve controllable
- High electrical conductivity : Low electrical resistance
- Printing characteristics : easy to use, good line resolution
- Addition of different ceramics for adjustment possible

# Product Introduction - Piezo

## Product Introduction



Ag paste



Product No.	Application	Filler	Application method	Sintering condition
CSP-0960	Piezo buzzers	Ag 60%	Screen printing	800°C

## Characteristics

Characteristic	
Fr.(kHz)	105
Resist.(Ω)	4.1
Fa.(kHz)	123
Capa.(nF)	20
Kp(%)	0.7

## Summary

- Excellent solderability
- Strong adhesion to piezo-ceramics
- Controlled shrinkage



# Customers

Look forward to working with you!



**Functional Paste Division**