

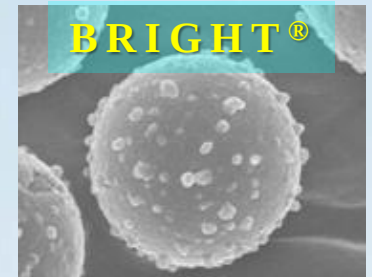
Introduction of SMERF[®] and the Latest ACP Technology



NIPPON CHEMICAL INDUSTRIAL

Contents

1. Electro - Conductive Particles : BRIGHT®



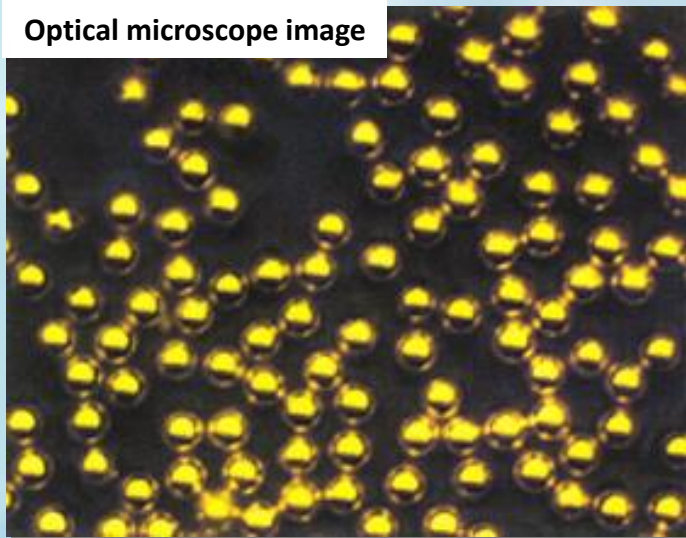
2. NCI's ACP : SMERF®

Anisotropic Conductive Paste (ACP) properties

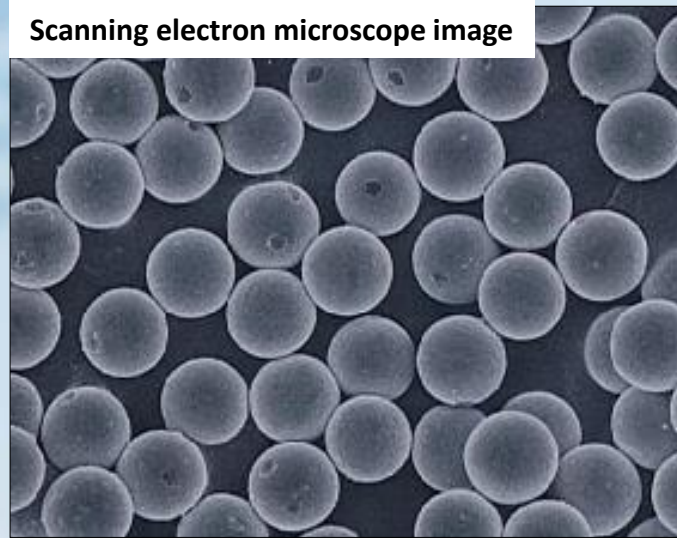


1. Electro - Conductive Particles BRIGHT[®]

Optical microscope image



Scanning electron microscope image



Gold / Nickel coated resin particles

Particle size : 4.6 μ m

Smooth surface

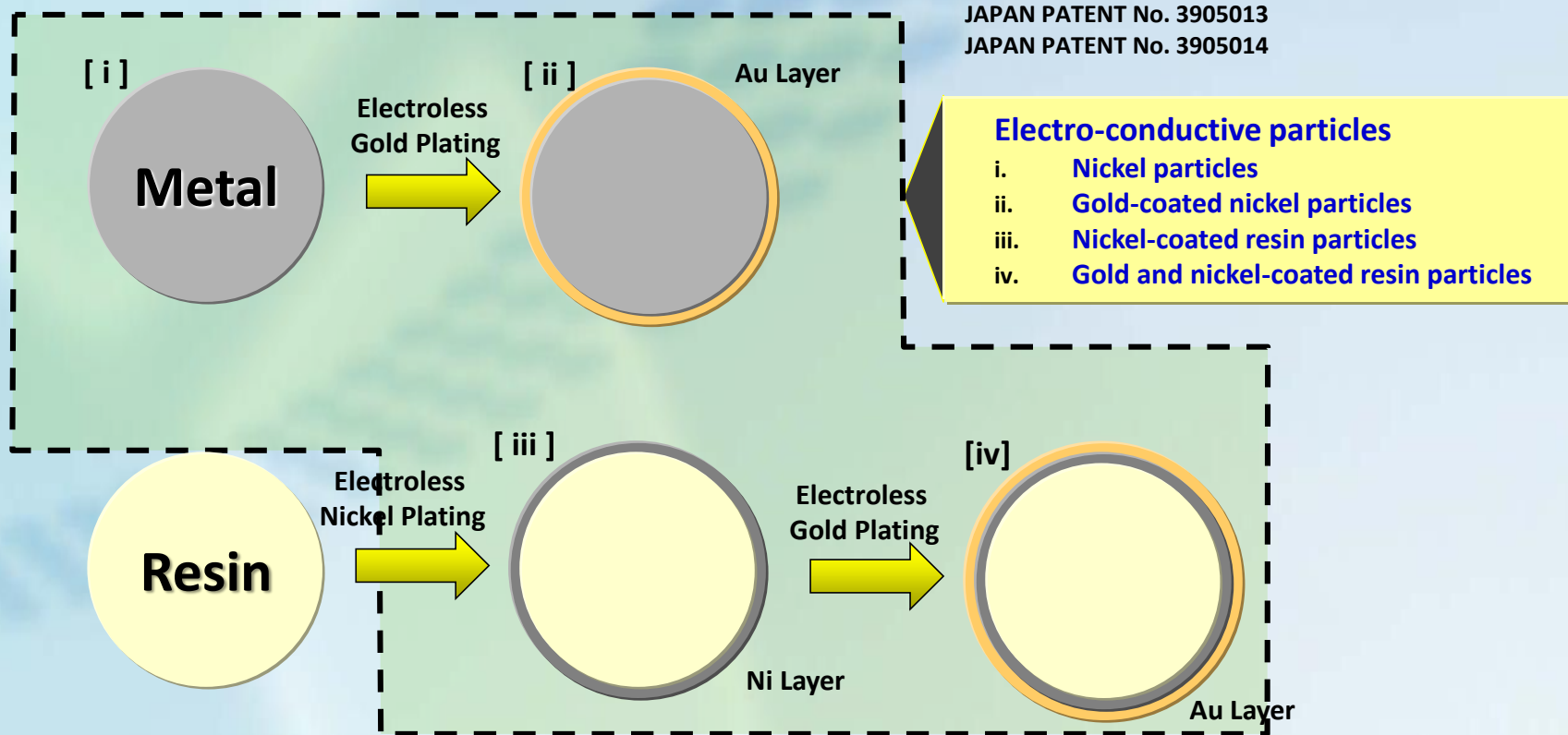
NCI has advanced metal coating technology for various fine particles.

Electro - Conductive Particles

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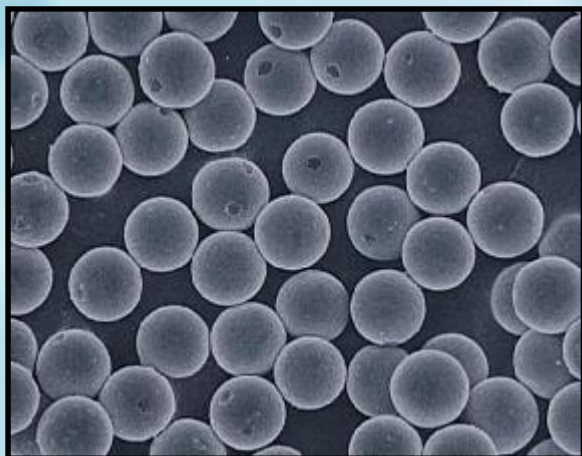
NCI has original metal coating technology for various fine particles such as silica, carbon, nickel and resin.

Principal products



These particles are applied to SMERF

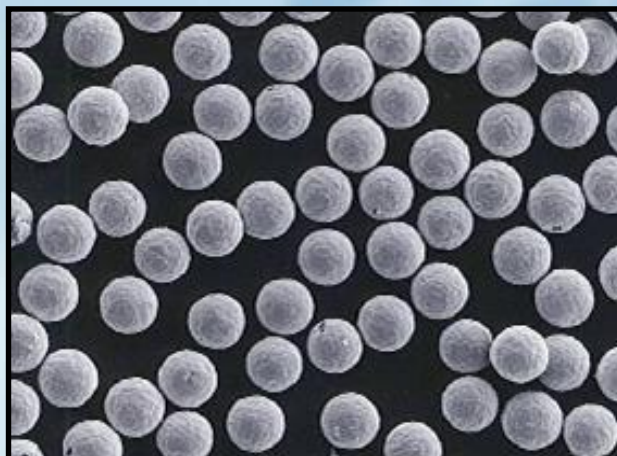
GNR-EH (Smooth or Spiky) , GNR-MX, GNM-Ni



5μm

GNR-EH (D)

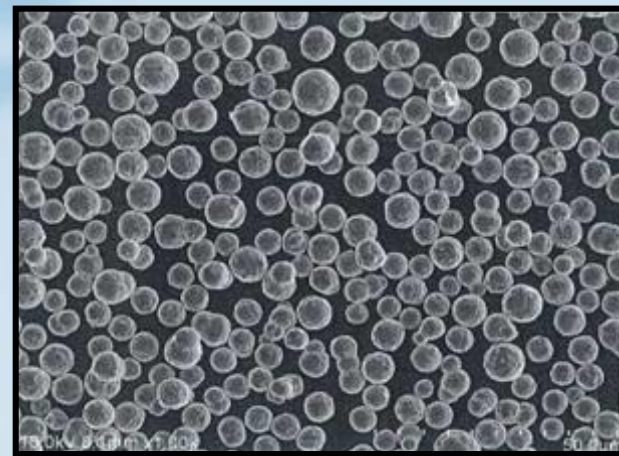
Standard Type
Benzoguanamine



5μm

GNR-MX

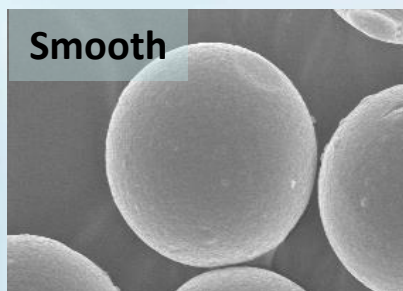
Soft Type
PMMA



5μm

GNM-Ni

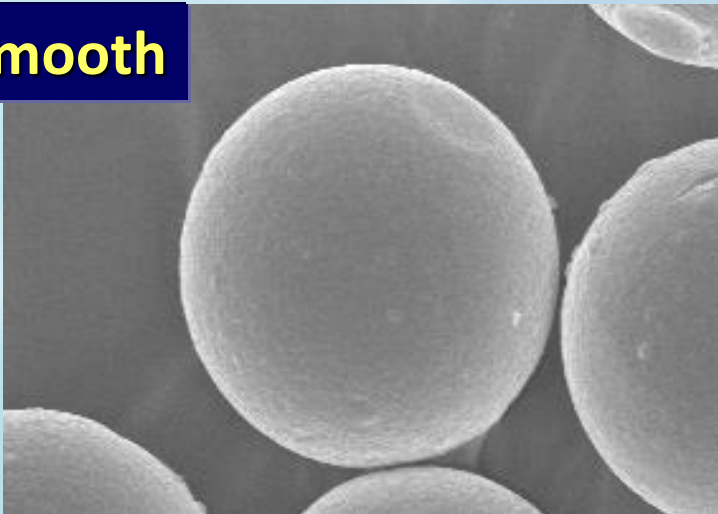
Ni Core



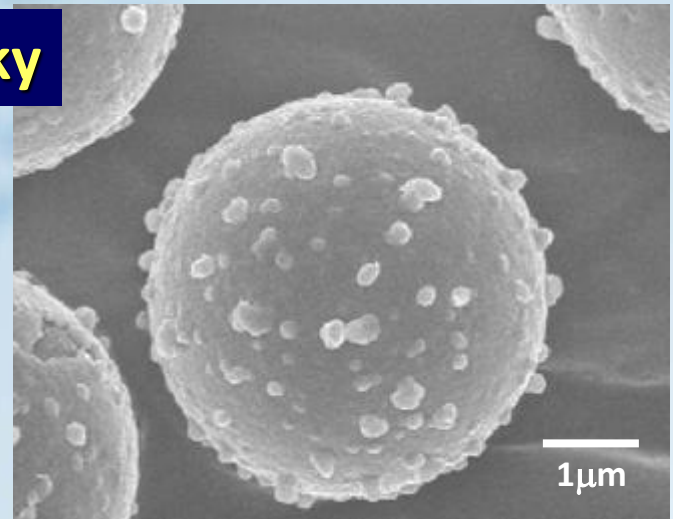
Surface Morphology of GNR-EH : GNR-EHD

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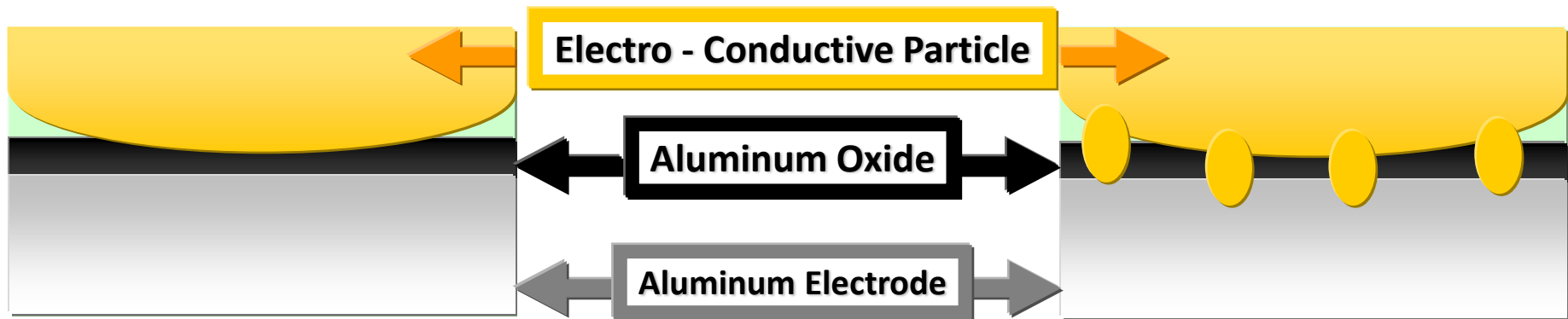
Smooth



Spiky



Effects of Surface Morphology



Types of Electro - Conductive Particles

Grade	Core	Particle Size (μm)	Coatings	Hardness
GNR - EH	Benzoguanamin resin	Custom Made 3.0 ~ 10.0	Ni or Ni / Au	Standard Type
GNR - EHD (Spiky Type)				
GNR - MX	Acrylic resin (PMMA)	4, 5, 10, 15, 20, 30	Ni or Ni / Au	Soft Type
GNR-KS1D (Spiky Type)	Styrene resin	3.0	Ni or Ni / Au	High Elasticity Type
Ni Powder	Metal (Classified Ni Powder)	2.5, 6.5, 10	-	
GNM - Ni		2.5, 6.5, 10	Au	

Various types of conductive powders can be selected from our standard and customized grades.
GNR-EHD 3.0 μm spiky , **GNR-KS1D 3.0 μm spiky** and **GNM-Ni 2.5 μm** are mainly used for SMERF.

2. NCI's ACP : SMERF



Features of SMERF

Features of SMERF

- ◆ **One-component epoxy systems**

- ◆ **Long pot life**

SMERF viscosity does not increase after 2 weeks at 30°C

- ◆ **Widely applicable for all ACP supply systems**

Acceptable for stencil masks, dispensing, and jetting application systems

- ◆ **SMERF products can be customized to meet specific applications and customer requirements**

- ◆ **High quality**

No Agglomerated Particles, No over-sized particles, No foreign materials,
Keep homogeneous (Non-settling)

- ◆ **Faster Cure**

8-10 sec./ 170°C, 6-7 sec./ 180°C

(Depending upon bonding conditions, formulation and materials used)



Features of Cured SMERF

Features of cured SMERF

- ◆ **Low electro-resistance**

SMERF is a series of excellent ACPs using metal coated powders.

- ◆ **Excellent fillet appearance with fewer bubbles**

- ◆ **High reliability and uniformity**

High electro conductivity. Over 20N/mm² die shear strength.

TH : 85'C/85%RH/1000H.,

TC : -40'C ⇔ +80'C/500cycles,

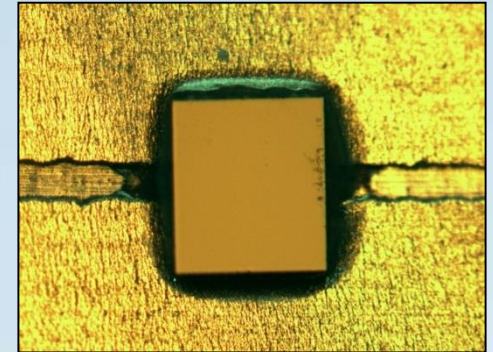
PCT : 120'C/100%RH/2atm/10H. [Passed]

- ◆ **Adaptable for combinations with any IC and antennas**

Can be used with UHF and HF ICs, Cu, Al and Silver antennas

- ◆ **Good adhesion and high reliability in various materials of antennas**

- ◆ **Absorbs stress to inlay materials by resin particle flexibility**

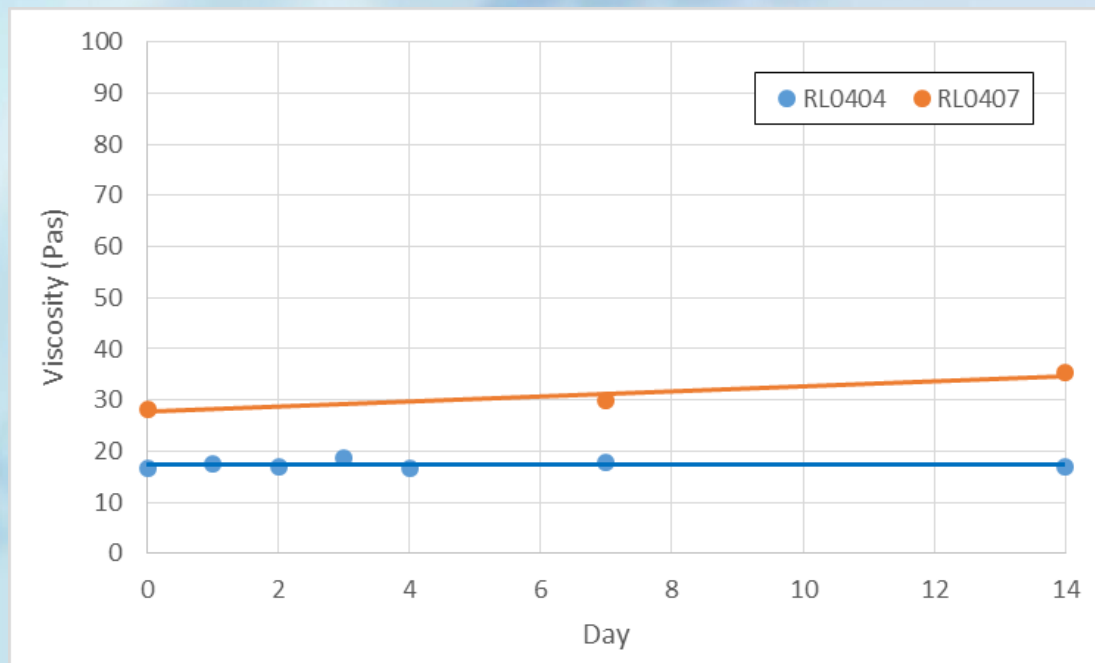


Properties of SMERF

SMERF		RL0404 (Standard)	RL0504 (High reliability)	RL0407 (Standard)	RL0507 (High reliability)
Application		Dispensing, Jetting		Dispensing, Jetting	
Electro conductive particles Various types of powders can be selected from our standard and customized grades.	Core	Benzoguanamine	Resin (Trade secret)	Benzoguanamine	Resin (Trade secret)
	Coating(s)	Ni / Au	Ni / Au	Ni / Au	Ni / Au
	Particle size	3um	3um	3um	3um
	Distribution	Very tight	Very tight	Very tight	Very tight
Viscosity (Rheometer)	1 [1/s]	27 [Pas]		40 [Pas]	
	10 [1/s]	11 [Pas]		17 [Pas]	
	20 [1/s]	9 [Pas]		16 [Pas]	
Thixotropic index (Rheometer)	1 / 10	2.5		1.7	
	10 / 20	1.2		1.1	
	10 / 100	1.5		1.2	
Gel Time	150°C	20 [sec.]		20 [sec.]	
Tg	DSC	115 [°C]		120 [°C]	
Water adsorption	100°C, 2hrs.	0.4wt%		0.4wt%	
Coefficient of liner expansion (TMA)	A1	67 [ppm/K]		68 [ppm/K]	
	A2	188 [ppm/K]		180 [ppm/K]	
Young’s modulus	MPa	2850		2990	
Pot Life		2 weeks at 25°C / 6 months at < 0°C			

Pot Life at 30°C

Viscosity [Pa·s] (1[1/s])	Original	1day	2days	3days	4days	7days	14days
RL0404	16.7	17.4	17.1	18.7	16.7	17.8	17.0
RL0407	28.3					29.8	35.3



Viscosity of SMERF RL0404 and RL0407 does not increase after 2 weeks. (no increase after 1 month)
 Long pot life ACP has an advantage for handling properties and cleaning frequency of application equipment.

Evaluation Methods

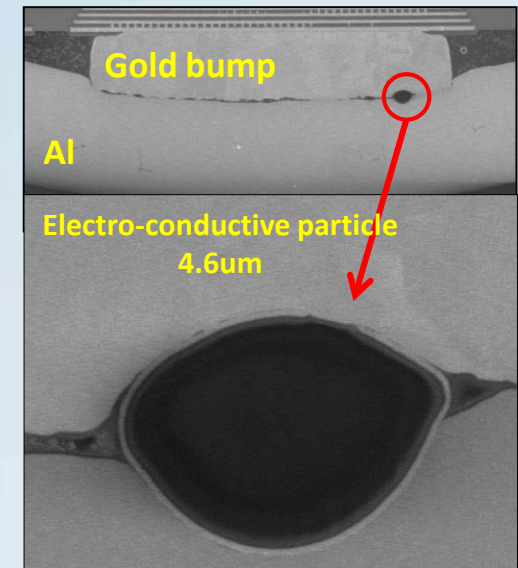
- ◆ Bonder (Manual)
Muhlbauer TTS300 Pressure : 0.5 N ~ 9 N Temp. : ~ 300 °C
UV Bonder



Muhlbauer TTS300

- ◆ Performance of HF and UHF
HF : Microporss / MP300 MT2
UHF : voyantic / tagformance
- ◆ Reliability test
Reading test (HF, UHF), HF tester (Q factor)
PCT, Thermo - hygroat test,
Die shear test,
Bending test. ($\phi 10, 20\text{mm}$)
Thermo cycle test
Electric resistance measurement

- ◆ Analysis Equipment
Rheometer, MCTM,, TEM, EPMA, **FE – SEM, FIB**

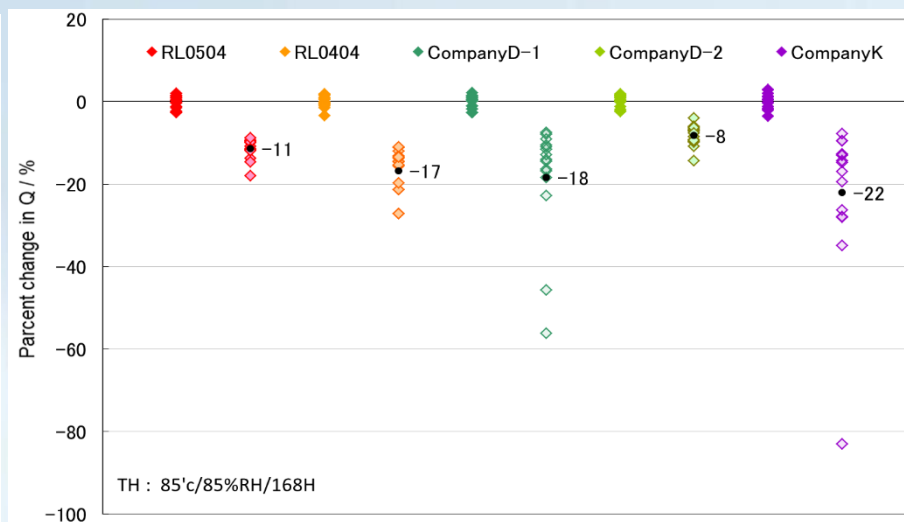
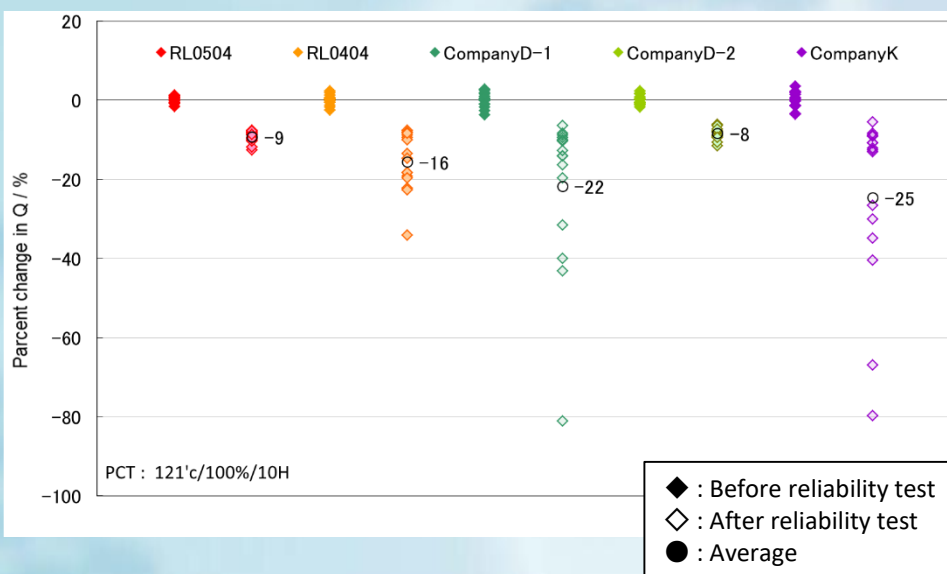


Cross section of electro conductive particle after bonding

Reliability Test (HF Tag)

Bonding condition

Antenna	Al / PET (HF)
IC	I-CODE SLI
ACP	RL0504 (High reliable ACP, Resin core) RL0404 (Au/ Ni / Resin core), Company D -1 (Au/Ni core) ,Company D -2 (Ni), Company K (Ni)
Bonding Machine	Muehlbauer TTS300
Temperature	Upper 185°C / Lower 185°C
Pressure	2.9N
Time	9sec.
ACP Application	Dispense



Reliability Test (UCODE7 UHF tag)

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Bonding condition

Antenna	Al / PET (UHF)
IC	U·CODE7
ACP	RL0407(Au/ Ni / Resin core) RL0507 (High reliable ACP, Resin core)
Bonding Machine	Muehlbauer TTS300
Temperature	Upper 170°C / Lower 170°C Upper 175°C / Lower 175°C
Pressure	1.0N , 1.2N
Time	7 sec.
ACP Application	Dispense
Reliability	Pass : < ±2.0dBm

TH : 85°C/85%RH 168H.

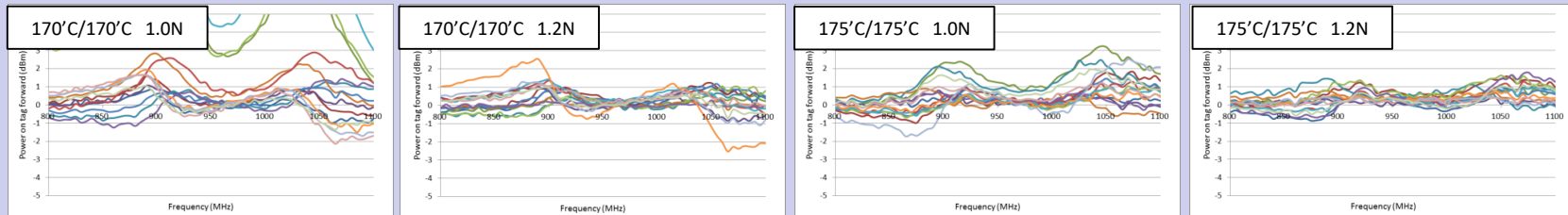
Pass ratio (%)

Temperature	170°C/170°C		175°C/175°C	
Pressure	1.0N	1.2N	1.0N	1.2N
Time	7sec.			
RL0407	60%	80%	93%	100%
RL0507	100%	100%	100%	100%

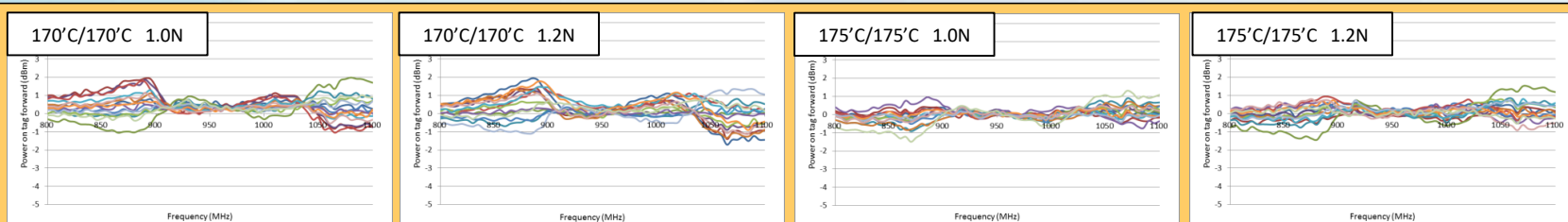
RL0507 gives high reliability under all bonding condition.

Power on Tag (dBm Change before and after TH test)

RL0407



RL0507



Reliability Test

(MonzaR6 UHF tag)

Bonding condition

Antenna	AI / PET (UHF)
IC	MonzaR6
ACP	RL0407(Au/ Ni / Resin core), RL0507 (High reliable ACP, Resin core)
Bonding Machine	Muehlbauer TTS300
Temperature	Upper 175°C / Lower 175°C
Pressure	0.8N, 1.0N, 1.5N, 2.0N
Time	7 sec.
ACP Application	Dispense
Reliability	Pass : < ± 2.0 dBm

TH : 85°C/85%RH 168H.

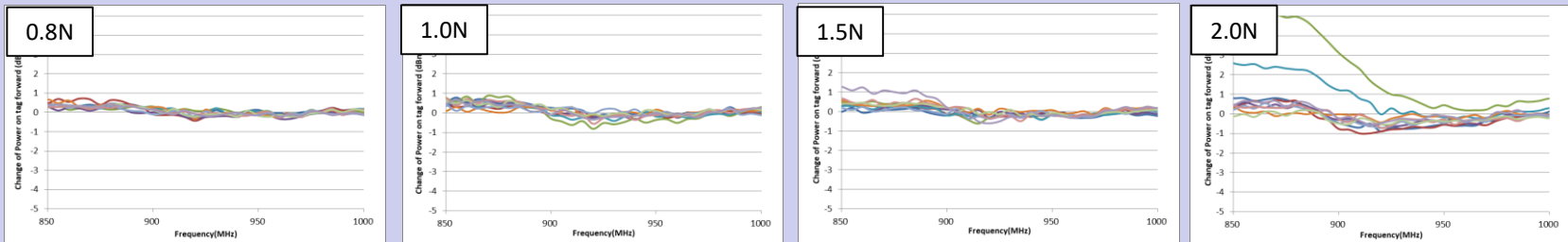
Pass ratio (%)

ACP	Pressure			
	0.8N	1.0N	1.5N	2.0N
RL0407	100%	100%	100%	70%
RL0507	100%	100%	100%	90%

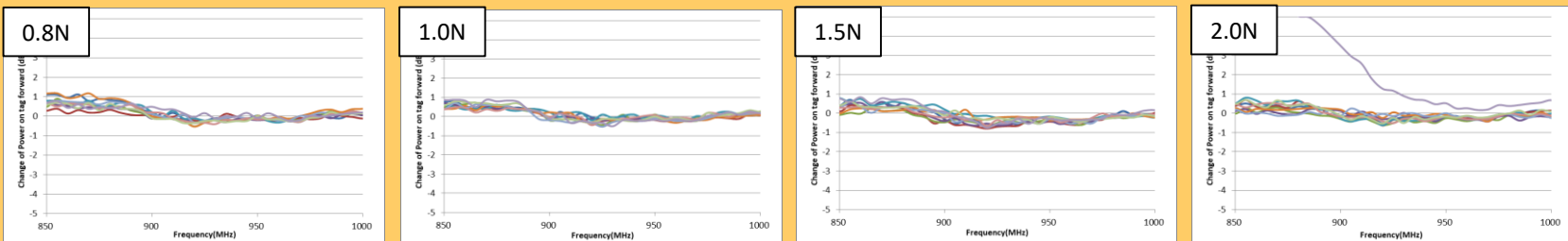
RL0407 & RL0507 gives high reliability under low bonding pressure.

Power on Tag (dBm Change before and after TH test)

RL0407



RL0507



Conclusion

- ✕ NCI has various electro conductive particles, trade name **"BRIGHT[®]"**.
- ✕ NCI manufactures ACP using **BRIGHT[®]**, trade name **"SMERF[®]"**.
- ✕ **SMERF[®]** has a lot of advantages for die attach process (Inlay production).
- ✕ Please feel free to contact us if you have any questions, comments or sample requirements.

Contact us

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