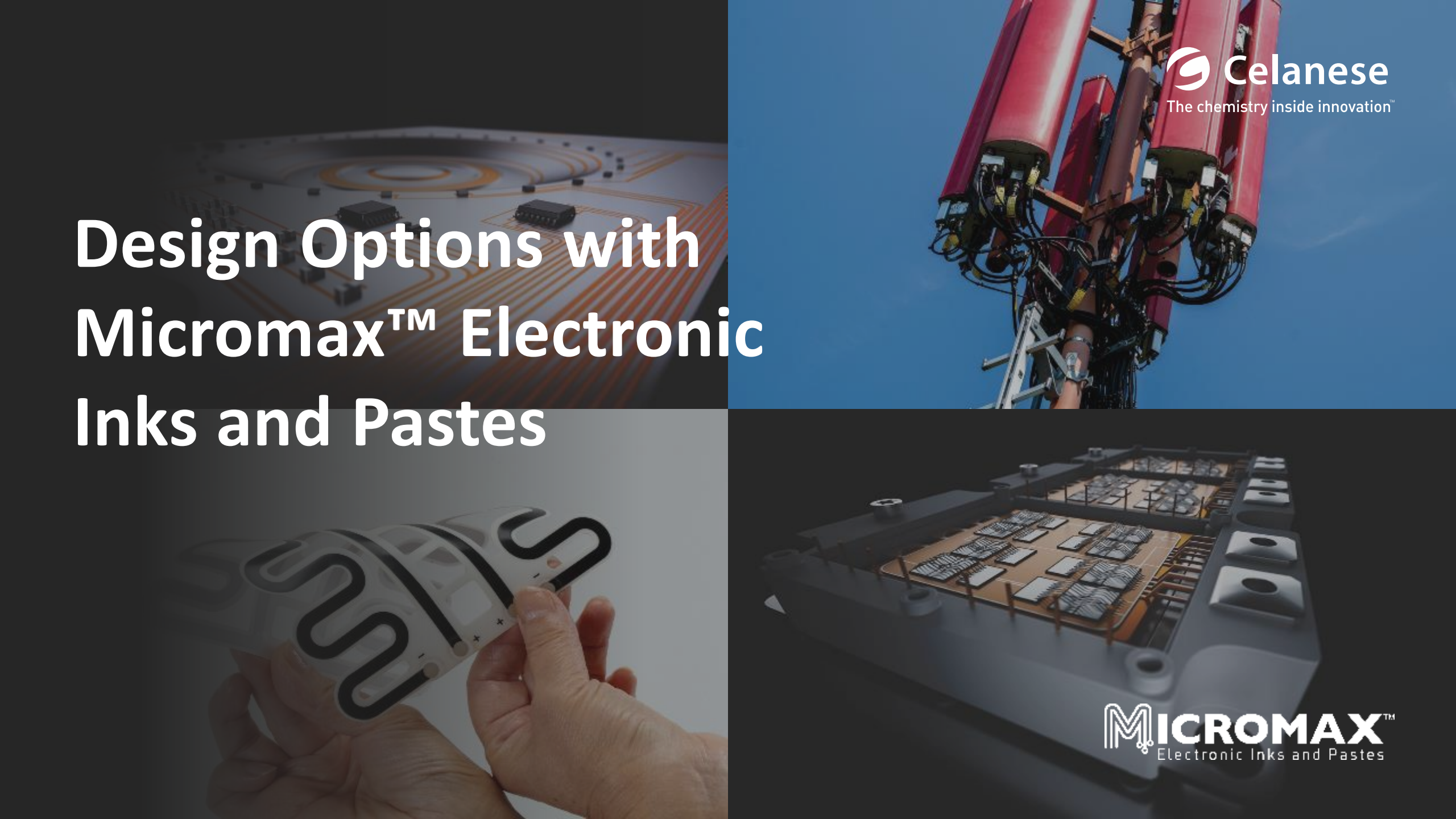


Design Options with Micromax™ Electronic Inks and Pastes

Celanese Corporation Overview

We are a global chemical and specialty materials company that engineers and manufactures a variety of products essential to everyday living.

我们是一家全球化学和特种材料研发和生产企业 --- 塞拉尼斯成立于1918年，迄今已有106年历史

- Global headquarters in Dallas, Texas, USA 全球总部设于美国德克萨斯州达拉斯
- Approximately 12,400 employees globally 全球约12,400名员工
- $10.9 billion in net sales in 2023 (highest in company history) 2023年净销售额达109亿美元
- Number 396 on the 2021 FORTUNE 500 list 《财富》美国500强中排名第396位
- 50 owned and operated manufacturing locations; operations in 27 countries worldwide 全球50家自营和营运制造工厂，足迹遍布全球27个国家
- Two leading businesses: Engineered Materials and Acetyl Chain 两大核心业务：工程材料和乙酰基链产品
- Innovation is at the core of our differentiated business model 创新是我们差异化的业务模式的核心

Celanese Micromax™

MICROMAX™
Electronic Inks and Pastes

Thick film inks and pastes that are conductive, resistive, dielectric and compatible with many substrate surfaces - polymer films, glass, metals, ceramics, textiles

厚膜电子浆料是在各类基材表面（聚合物薄膜、玻璃、金属、陶瓷、纺织品）形成功能性的互连与线路，具有导电性、电阻性、介电性等不同特性

Micromax™ Materials in EV Applications
Micromax™电子浆料在电动汽车中的应用

Celanese | MICROMAX™ Electronic Inks and Pastes

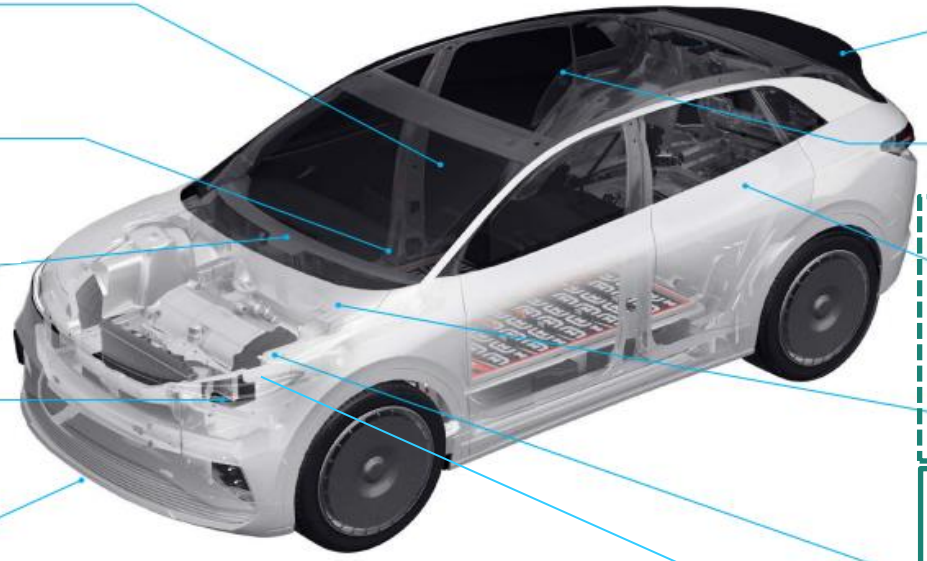
Seat Sensor
PTF PTC; Intexar™ Electronic Inks and Films

Cabin & Steering Wheel heating
Intexar Electronic Inks and Films

HMI, 3D Capacitive Switches
In-Mold Electronics Portfolio

LED Light Demister
In-Mold Electronics Portfolio

Millimeter Radar
Low-loss LTCC



5G (high frequency)
Low-loss LTCC, PTF Ag

Lidar (VSCEL & demisting)
Sinter Silver, Thick printing Cu & Ag, PTF silver

Battery (heater) Conditioning
PTF Ag & PTC carbon on polymer film

High-voltage Coolant Heater
ASxxx, 35xxN (metallizations on Al and steel)

Power Electronics (Inverter, DC/DC converter, OBC)
Die Attach Sinter Silver; Thick printing Cu & Ag

ADAS/CPU/GPU (Advanced package of chip)

Power Electronics 功率电子

MICROMAX™ Electronic Inks and Pastes

Thick Film Pastes (fired-on) | Thick Film Pastes (polymer) | Glass Ceramic Tape

Automotive

Thermal Conductive Applications and Recommendation 导热应用和银胶推荐

Celanese | MICROMAX™ Electronic Inks and Pastes

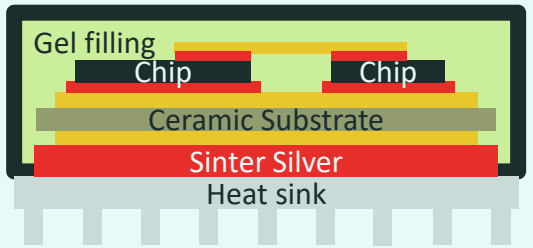
Tc

Sinter Ag
150~280 W/m.k
Metal contact
Ag, Au, Cu
(usually wire bonding)

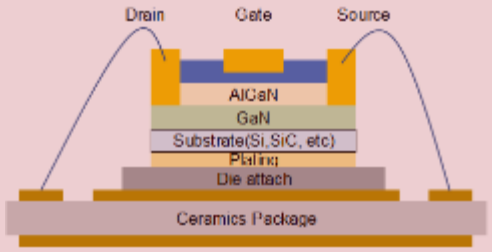
Pressure free sinter Ag (280 W/m.k, high modulus)

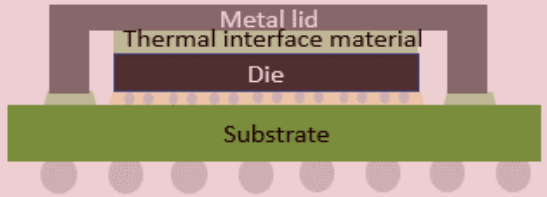
Pressure assisted sinter Ag (>200 W/m.k)

Pressure free sinter Ag (~110 W/m.k, low modulus)



Epoxy Ag
8~20 W/m.k
Non-metal contact
(flip chip and die attach)





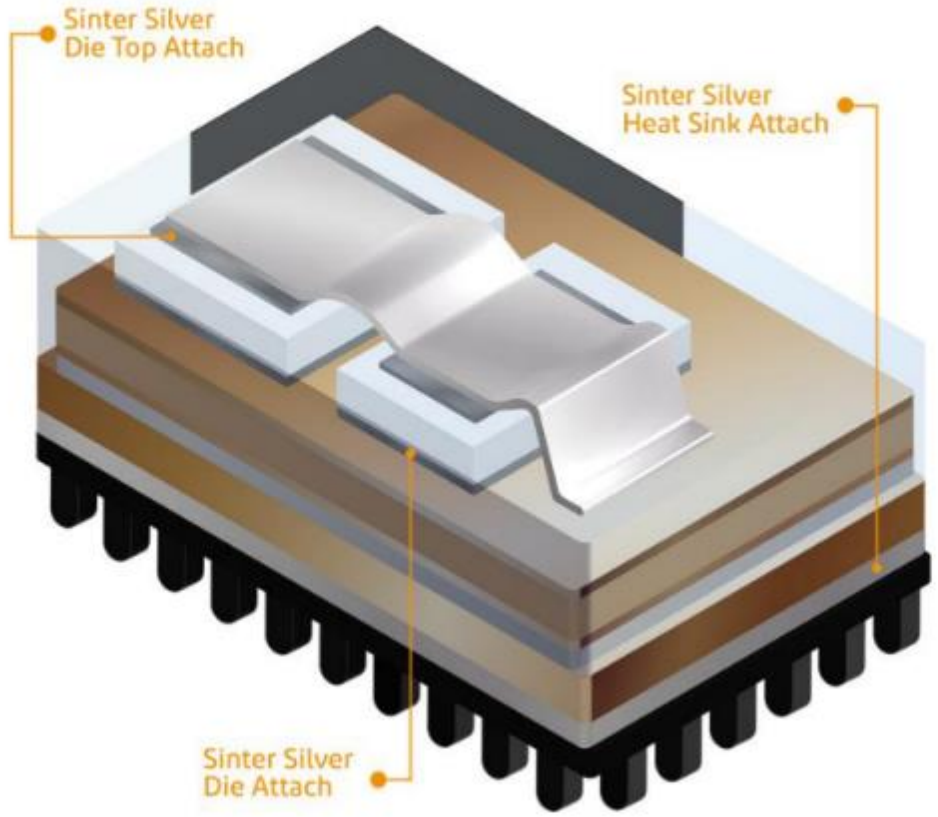
Epoxy Ag for die attach (~20W/m.k)

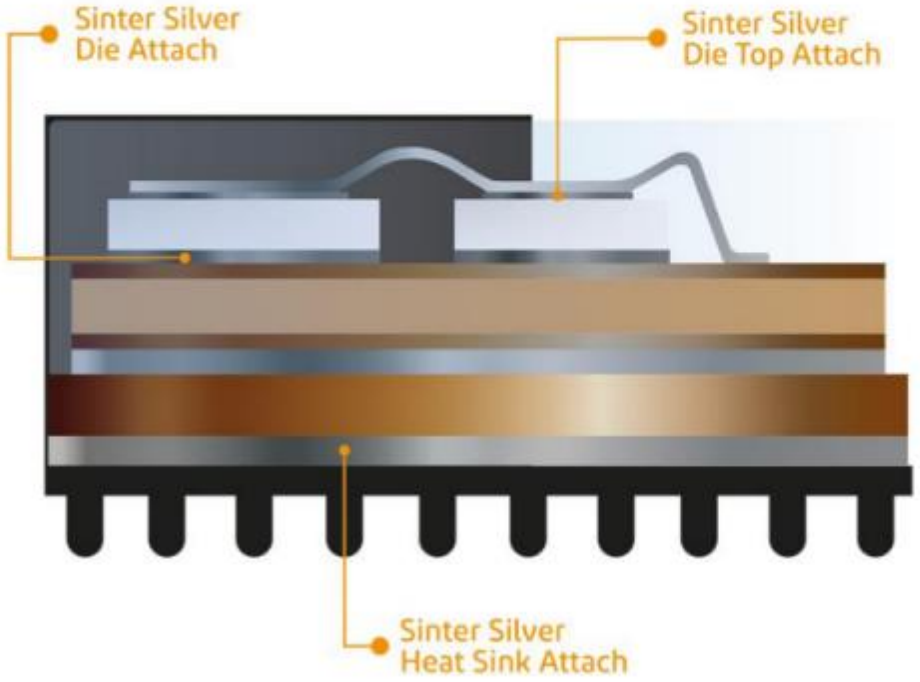
Epoxy Ag for TIM1 and die attach (10~15W/m.k)

Chip size

2mm x2mm | 4mm x4mm | 6mm x6mm | 8mm x8mm | >10mm x10mm

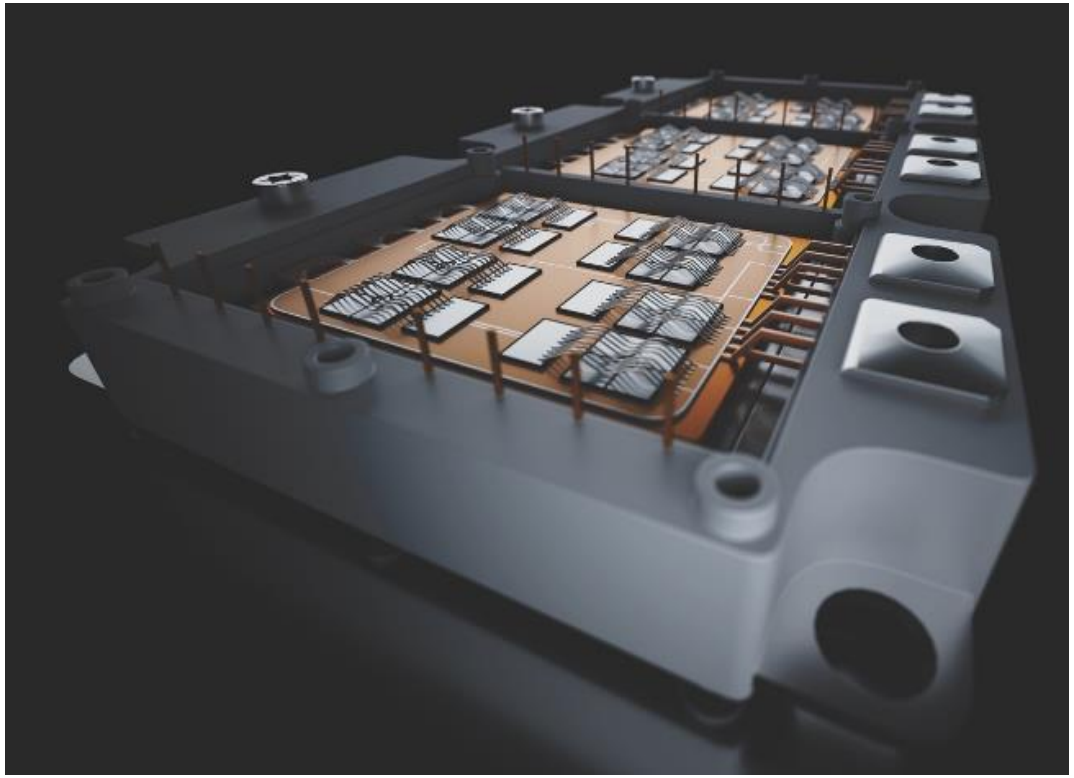
Introducing Micromax™ Pressure Sinter Silver
Micromax™ 辅压烧结银的介绍 – DA510/DA51x



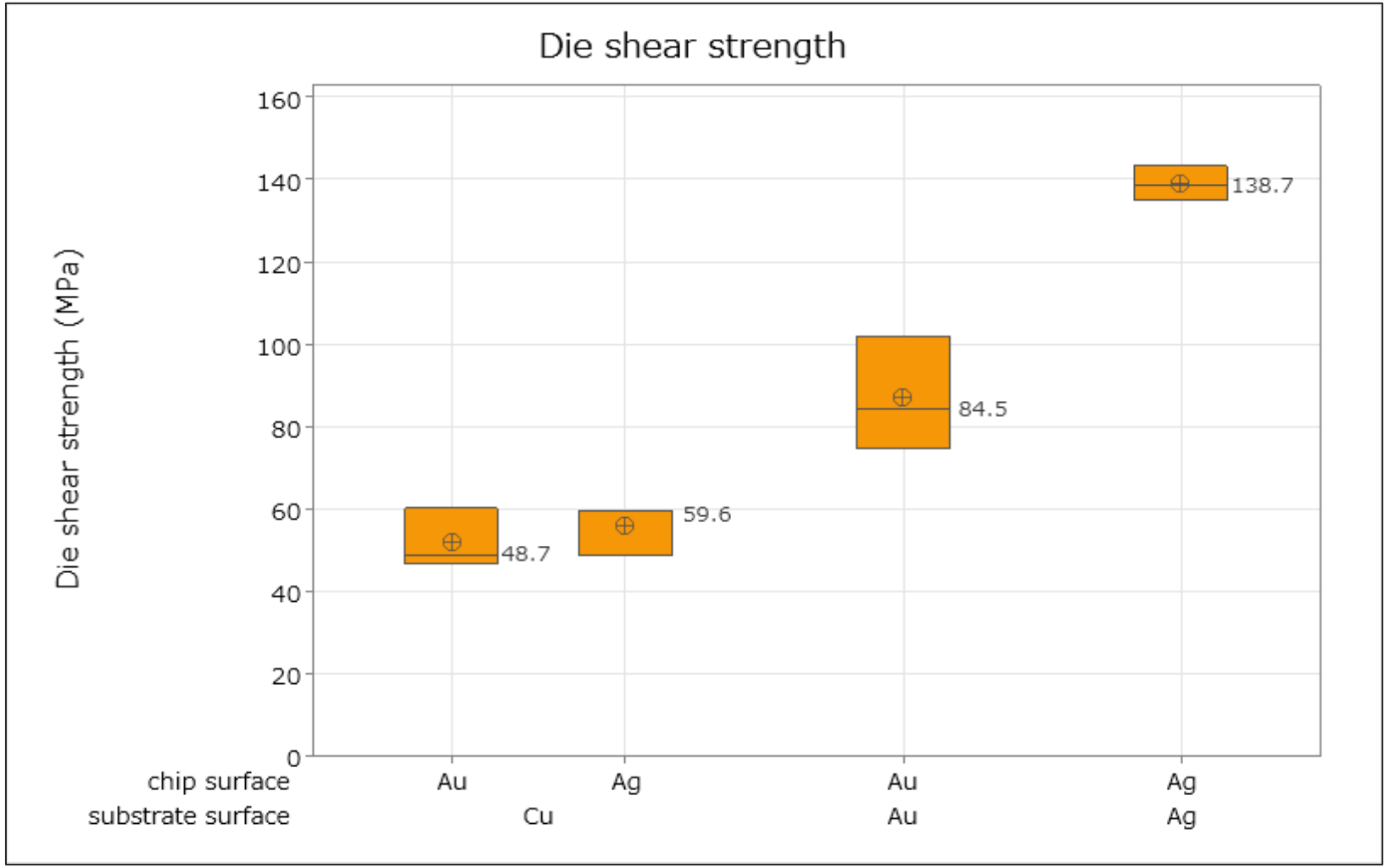


Pressure Sinter Silver : DA510 Features & Performance
辅压烧结银 ： DA510特性与性能

- Long work life at room temperature 室温下工作寿命长
- Good printability 良好的印刷适性
- Pressure-assisted sintering process 辅压烧结工艺
- Air or N2 atmosphere sintering 空气或氮气气氛烧结
- Bond to Au, Ag and Cu 与金、银和铜的良好键合
- Applicable for SiC or high-power Si power module, survives >2000 cycles of thermal shock (-55~175°C)
  适用于SiC或大功率Si基功率模块，可承受 >2000次热冲击（-55~175°C）



Pressure Sinter Silver DA510: Shear Strength with Metals
辅压烧结银 DA510：与金属的剪切强度



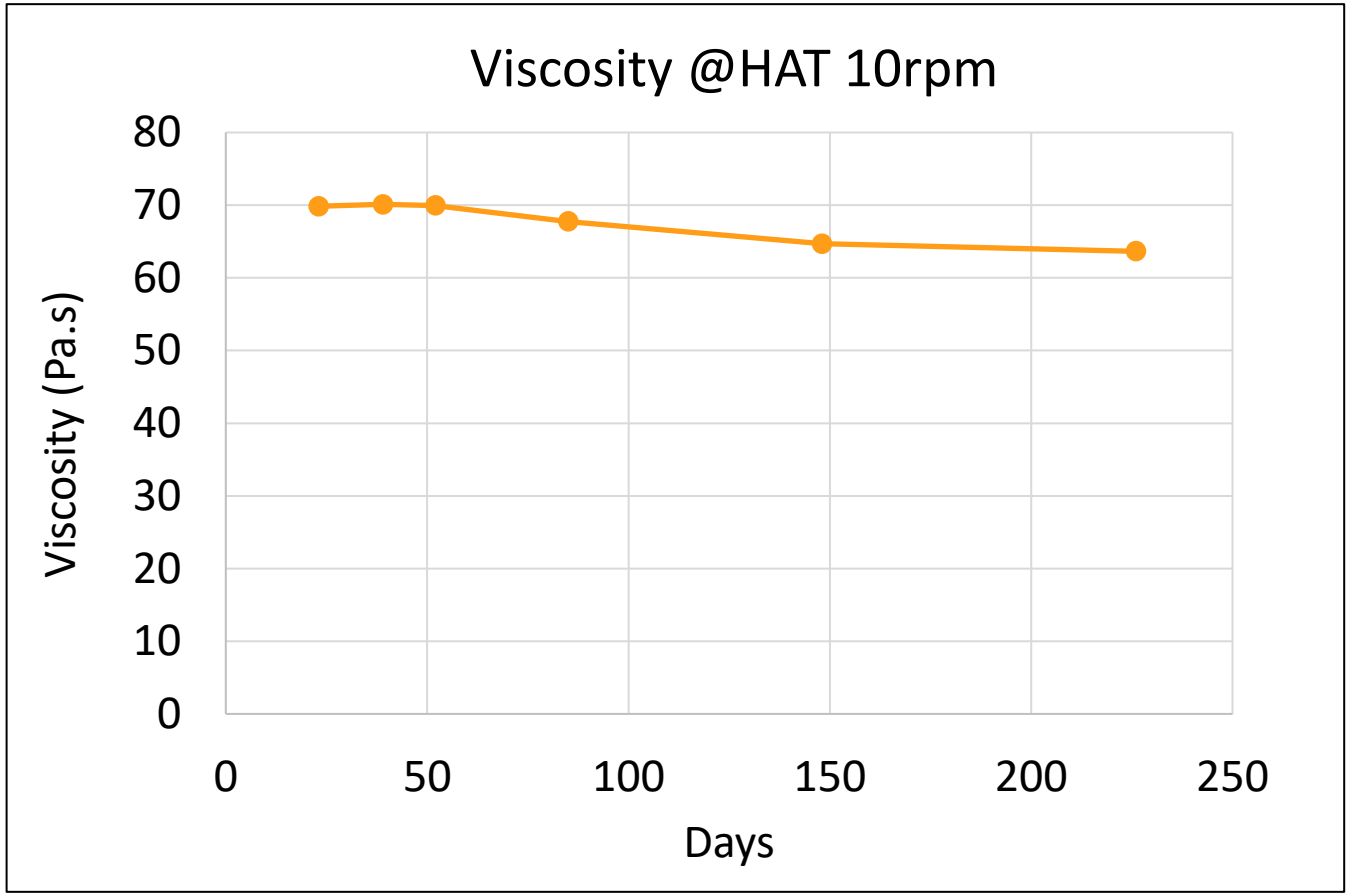
- **Achieve higher initial die shear strength on Au-Au or Ag-Ag bonding**
  在 Au-Au 或 Ag-Ag 粘合上实现更高的初始芯片剪切强度

Substrate: 1mm thick

Chip: 3mm square, 1mm thick

Sintering condition: 280°C/10MPa/1.5min

Pressure Sinter Silver DA510: Paste Stability (Viscosity)
辅压烧结银 DA510：浆料稳定性（粘度）

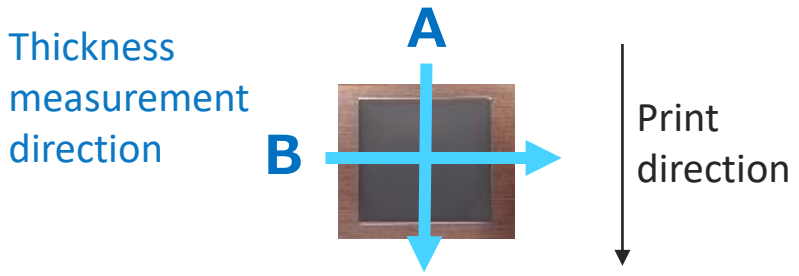


Good paste stability after >200 days room temperature storage
>200 天室温储存后，浆料稳定性好

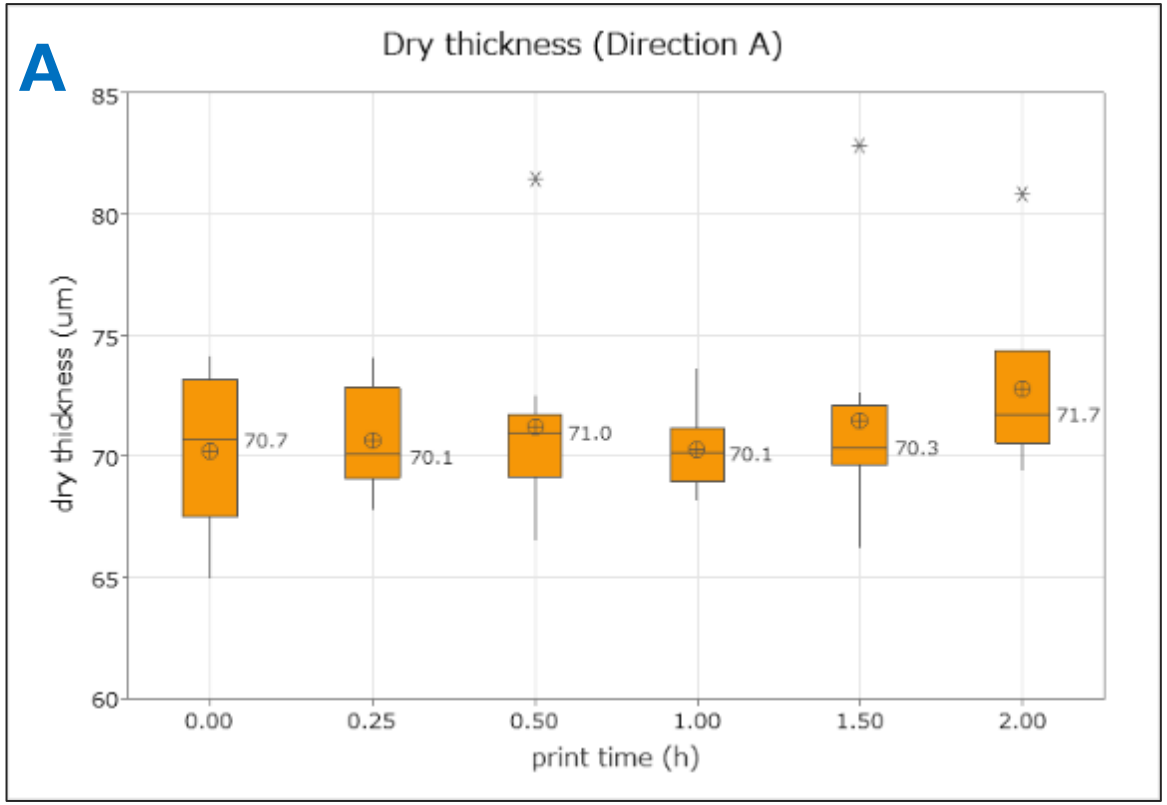
Pressure Sinter Silver DA510: Paste Work Life Test Result
辅压烧结银 DA510： 浆料工作寿命测试结果（印刷性）

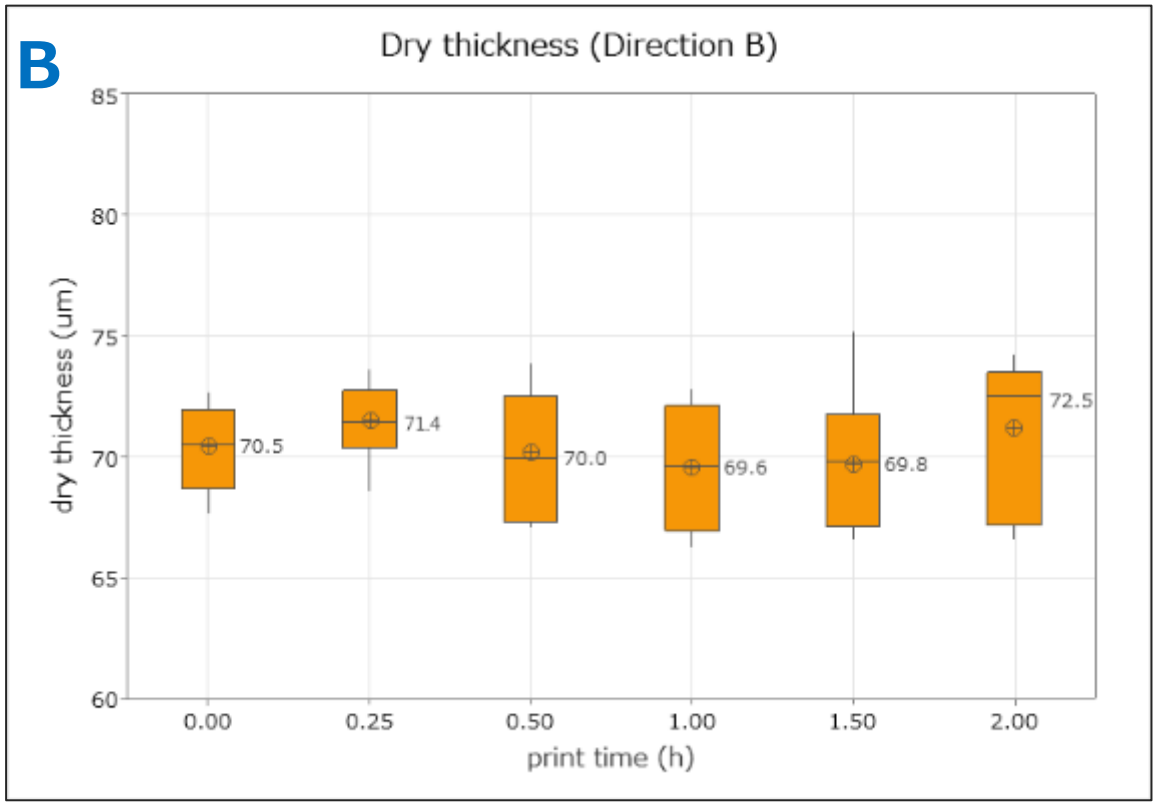
Dry thickness is stable even after 2 hours continuous printing

即使在连续印刷 2 小时后，干燥厚度也保持稳定



Dry thickness after continuous printing

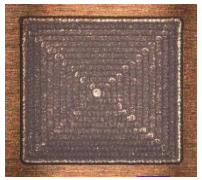
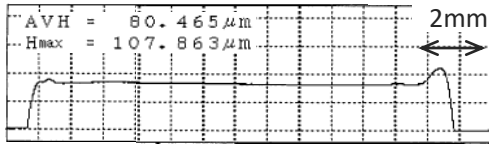
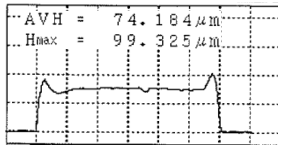
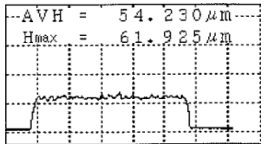
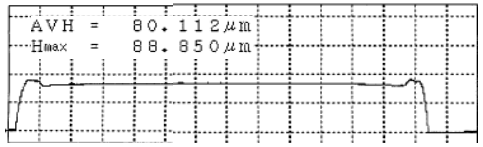
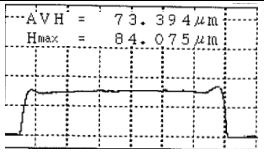
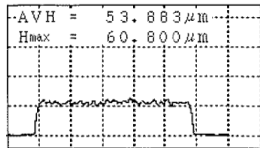




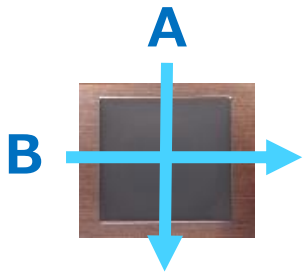
Pressure Sinter Silver DA51x: Applicable for Dispense
辅压烧结银 DA51x：点胶应用

Slit nozzle dispense & jetting dispense can be applied instead of metal mask printing

狭缝喷嘴点胶和喷墨点胶可以代替钢板印刷

	Metal mask print (13mm square pattern)	Slit nozzle dispense (6.5mm square pattern)	Jetting dispense (5mm square pattern)
Dried pattern	 Print direction		
Thickness profile Direction A	 100um		
Thickness profile Direction B			
Ra (um)	0.04	0.19	1.24

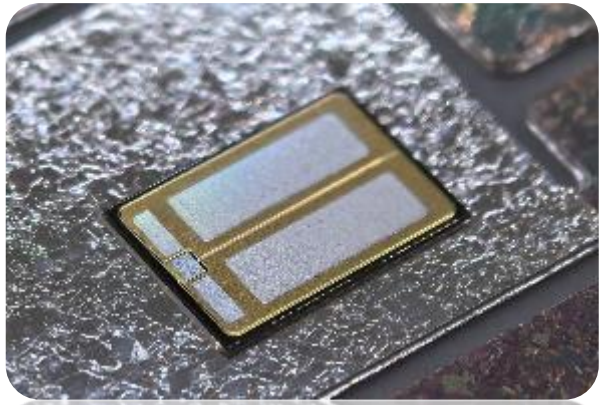
Thickness measurement direction



Pressure Sinter Silver DA51x: Die top attach application
辅压力烧结银 DA51x：芯片顶部贴装应用

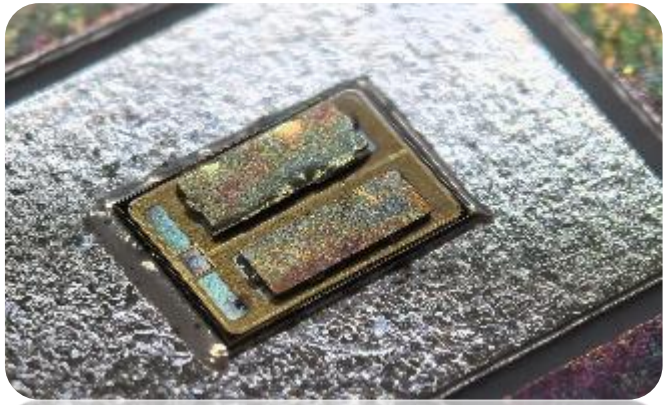
- Stable printability and dispensability without paste bleeding or fading at pattern edge

  稳定的印刷适性和点胶性，图案边缘不会出现溢胶或边缘塌陷



Die Attached

Die Top Dispensing DA51x

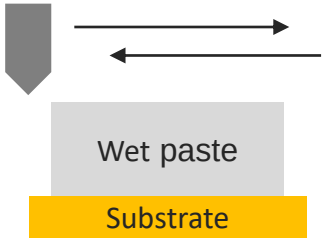
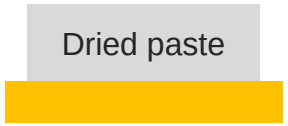
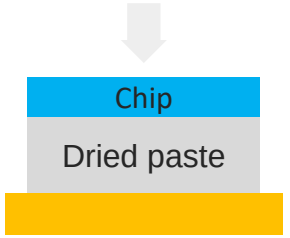
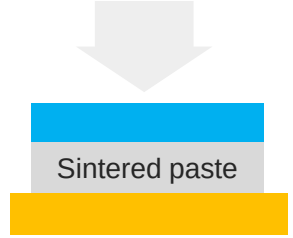
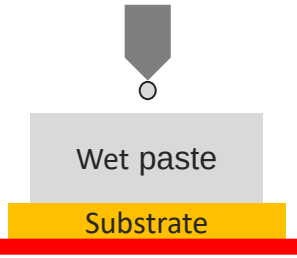
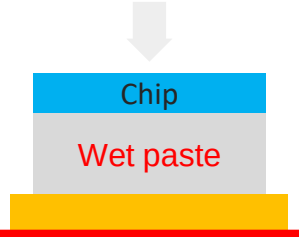
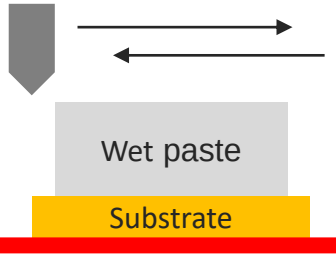
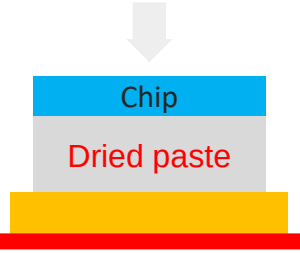
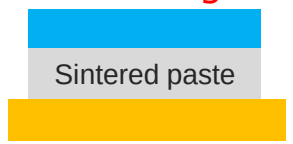


Die Top Attach

Pressure Free Sinter Silver Features & Performance
无压烧结银特性与性能

- Long work life at room temperature 室温下工作寿命长
- Good printability/dispensability 良好的印刷性/可点胶性
- Low fillet, Less residue 低爬胶，少残留
- Short sintering process time 烧结工艺时间短

Pressure free Sinter Silver: Dry chip mount process
无压烧结银：芯片干式贴装工艺

Category	Product type	Print	Dry	Chip Mount	Sinter
Pressure-assisted 辅压	DA510	Stencil printing	Oven	Chip mounter / Die bonder (dry mount)	Die bonder
					
Pressure-free 无压	Wet chip mount type	Dispense	-	Chip mounter (wet mount)	Reflow oven / Box oven
			skip		No pressure sintering 
	Dry chip mount type	Stencil printing	Oven	Chip mounter / Die bonder (dry mount)	Reflow oven / Box oven
					No pressure sintering 

Pressure free Sinter Silver: Paste property, Standard process condition 无压烧结银：浆料性能，标准工艺条件

Item	Q2905 Low modulus type	Q2906 High modulus type
Print method	Stencil print	
Chip size	≦ 7mm sq.	
Compatible surface	Ag, Au, Cu	
Dry	120degC/10min	
Chip mount	150degC (chip side) /175degC (substrate side) /1MPa/≦1sec	
Sintering atmosphere	Air or N2	
Sintering temp	280degC	
Sintering time	In-out 45min, Peak hold 30min	
Paste storage	Room temp	
Thermal conductivity (280degC/0MPa/30min sinter)	105 W/(m.K) in air No data in N2	288 W/(m.K) in air 125 W(m.K) in N2

Thermal Conductive Applications and Recommendation
导热应用和推荐

Celanese | MICROMAX™ Electronic Inks and Pastes

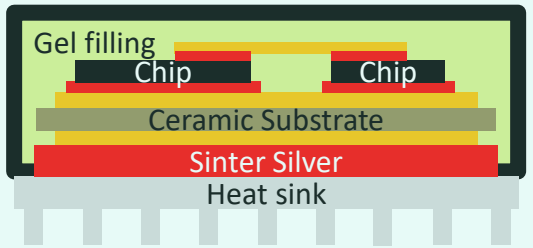
Tc

Sinter Ag
150~280 W/m.k
Metal contact
Ag, Au, Cu
(usually wire bonding)

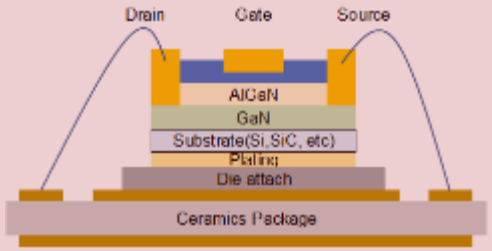
Pressure free sinter Ag (280 W/m.k, high modulus)

Pressure assisted sinter Ag (>200 W/m.k)

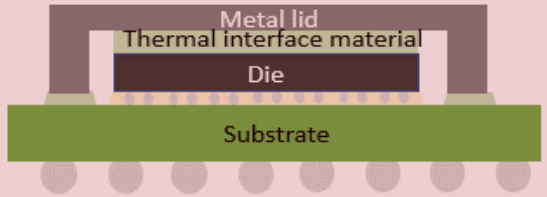
Pressure free sinter Ag (~110 W/m.k, low modulus)



Epoxy Ag
8~20 W/m.k
Non-metal contact
(flip chip and die attach)



Epoxy Ag for die attach (~20W/m.k)



Epoxy Ag for TIM1 and die attach (10~15W/m.k)

Chip size

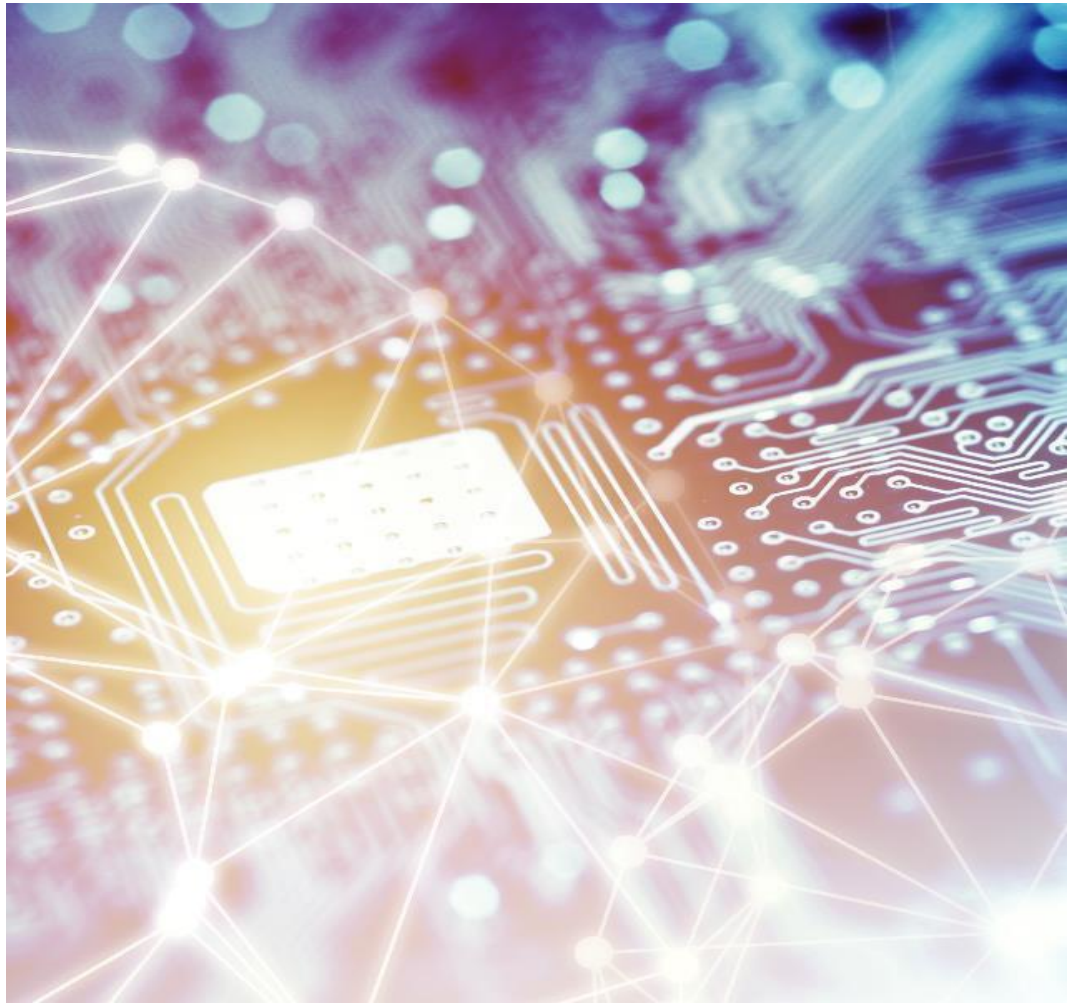
2mm x2mm | 4mm x4mm | 6mm x6mm | 8mm x8mm | >10mm x10mm

Micromax™ Epoxy Ag – CE 1709 Features & Performance
环氧树脂银 – CE 1709特性与性能

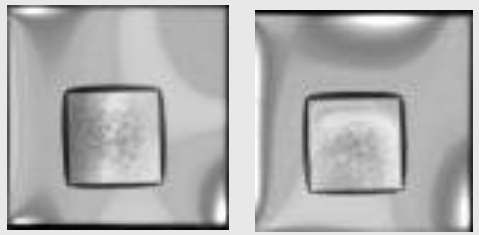
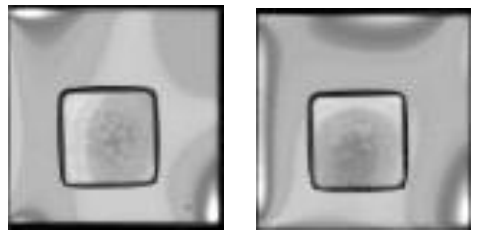
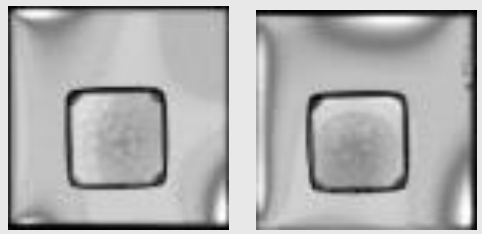
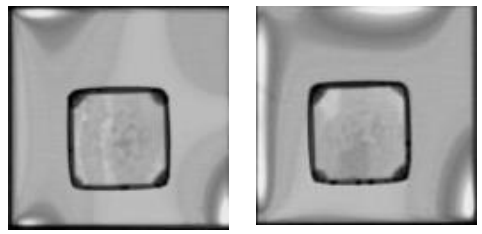
- High thermal conductivity (>10W/m.k)
  高导热系数
- Stable bonding to large chip (~10mmx10mm)
  与大芯片稳定粘接
- Low modules epoxy
  低模量环氧树脂
- High adhesion to metal lid to Si chip
  对金属盖与硅芯片的高附着力
- Excellent reliability
  出色的可靠性
- Designed for use for TIM1 in advanced flip chip package and die attach in wire bond package
  设计用于芯片封装中的 TIM1 和引线键合封装中的芯片贴装

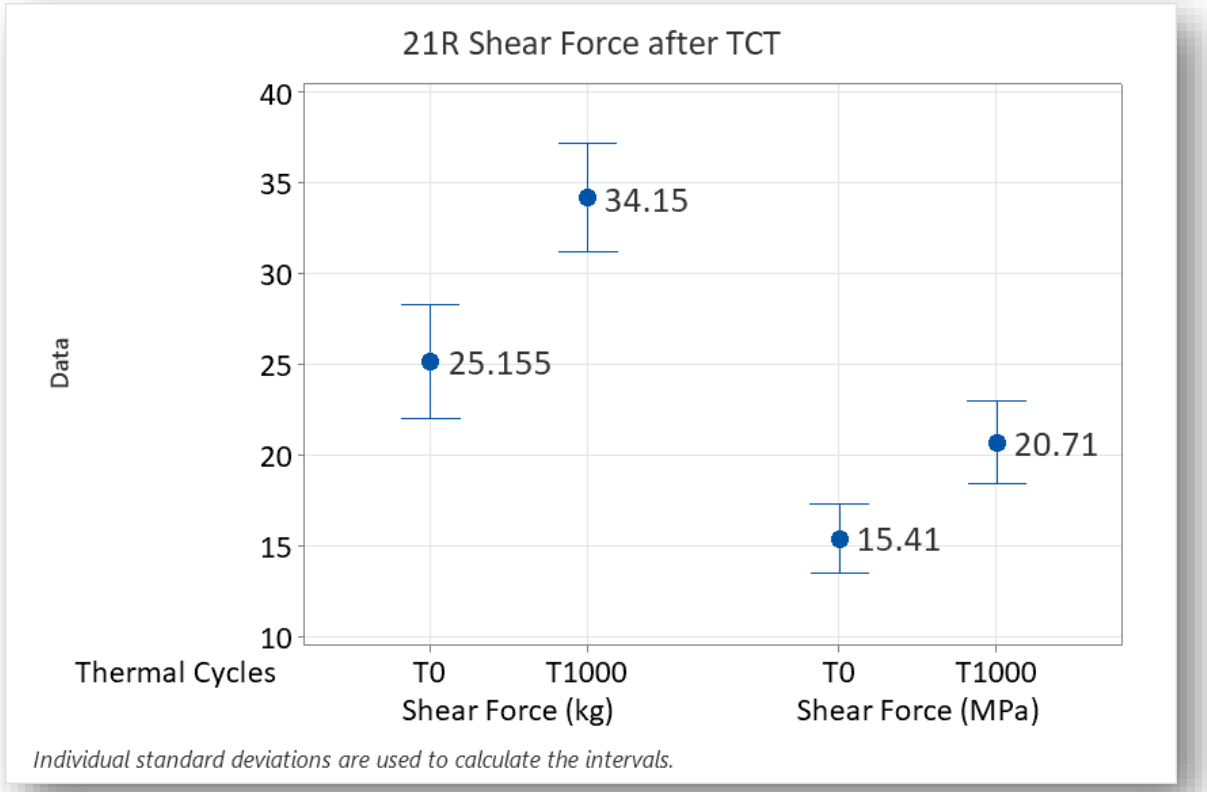
High thermal conductivity solution in package

封装中的高导热性解决方案



Micromax™ Epoxy Ag-CE 1709: reliability and adhesion
环氧树脂 Ag-CE 1709：可靠性和附着力

SAT Results (Through Scan)_ 10x10mm sq.	
T_0	
T_{300}	
T_{700}	
T_{1000}	



Chip: bare silicon
Substrate: bare copper
BLT: 75±5 µm
Curing profile: RT-120°C/1hr-175 °C/1hr
Thermal cycling test: -55°C to 125 °C (air)

Stable bonding quality before and after thermal cycle test

总结：Micromax™电子浆料在半导体封装中的应用

Category	Product	Key Property	Application	Value Statement
Sintering Ag	Pressure assistant: DA510/ DA51X	TC： > 200W/m.k	Die-Attach Top-Attach Heatsink-Attach	Room temperature storage and stable operation window 室温储存和稳定的工艺窗口
	Pressure free: Q2906 Q2905	TC： ~ 280W/m.k for high module TC： ~ 110W/m.k for low module	Die-Attach	Dry Chip mounting, less void, best BLT and residue control 干式芯片贴装，少空隙，最佳的 BLT 和残留物控制
Epoxy Ag	CE 1709	TC： 8-20W/m.k	TIM1 Die Attach	The best modulus epoxy Ag which enable large bonding area to the chip 最佳模量环氧树脂Ag，可实现与芯片的大面积键合

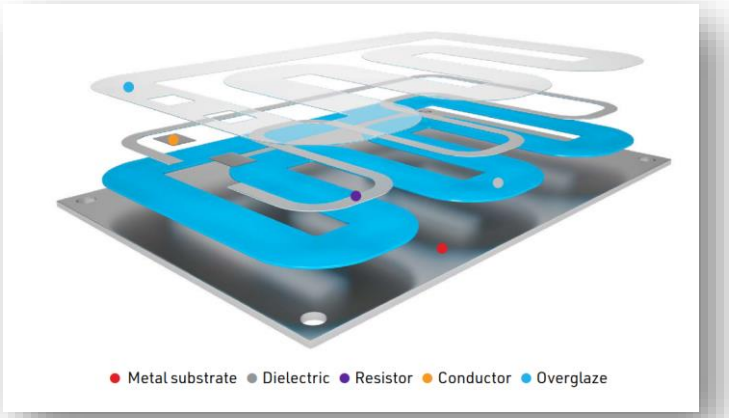
Micromax™ Thermal Management Solution

Celanese | MICROMAX™ Electronic Inks and Pastes

Heating On Steel

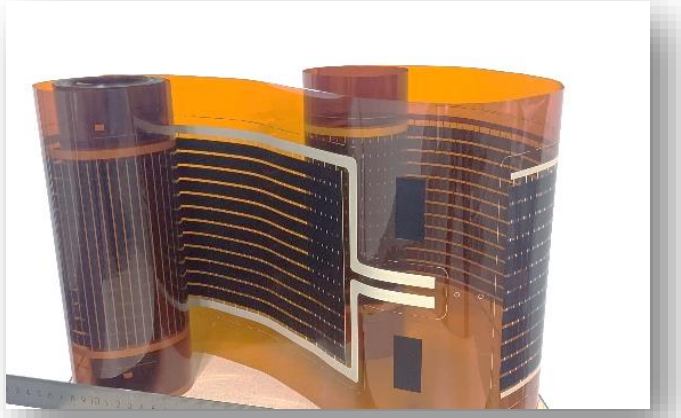
Category	Product	Key Property
绝缘介质	3500N	CTE: 10-11 ppm
导体	H6000/ LF131	Rs: < 2.6mOhm
电阻	Hxxx	20mOhm – 1.2Ohm
保护釉	3500N	CTE: 10-11

Heating On Aluminum



Category	Product	Key Property
绝缘介质	AS100	CTE： ~ 15ppm
导体	AS300	Ra: < 2.6mOhm
电阻	K2478/ K2479	40mOhm – 250m Ohm
保护层	5499	Polymer Encapsulant

PTF PTC Heating Film



Category	Product	Key Property
基材	PI/PET	高绝缘，高导热
导体	5025	Rs: < 15mOhm
自限温 PTC 电阻	PTC085 L/M/H	R 85℃/25℃ > 10
保护基材	PI/PET	高绝缘，高导热

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