JX Fine Cu Powder and Paste (under development)

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Advantages of JX Fine Cu Powder and Paste

- The novel surface treatments developed by JX can control sintering behaviors of Cu and can give an antioxidant effect to Cu.
  - Low-temperature sintering type: about 300degC
  - High-temperature sintering type: about 850degC
- Regardless of the sintering temperatures, JX's Cu pastes show low resistivity by optimizing the sintering conditions.
- JX Cu Paste used for die-bonding of power module can show high reliability, because of lower risk of electro-migration compared with that of Ag.

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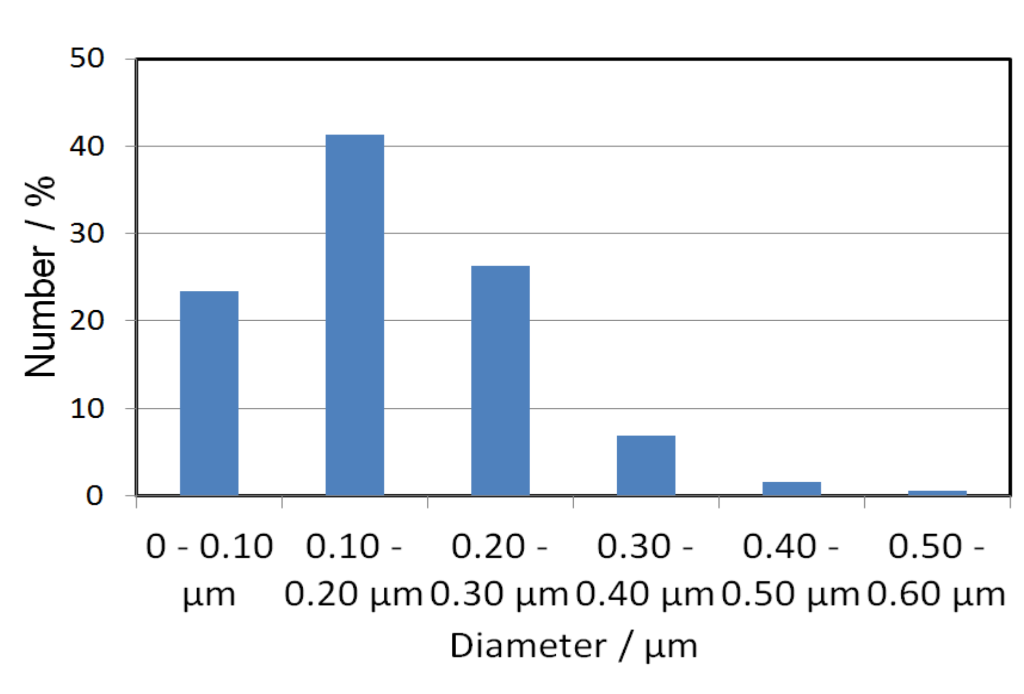
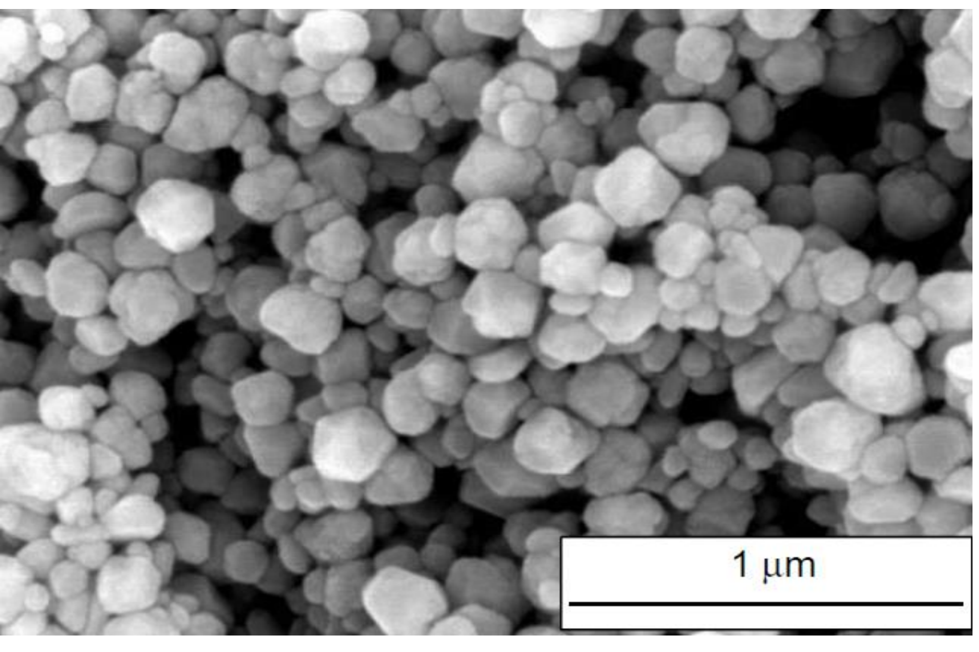
Typical Properties of JX Fine Cu Powder



Size distribution of JX fine Cu powder



SEM image of JX fine Cu powder

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Control of Sintering Behaviors

Sintering behaviors of JX fine Cu Powder

Sintering behaviors were evaluated by volume reduction of powder pellets-based on TMA analysis

Sintering behaviors can be controlled by the surface treatments.

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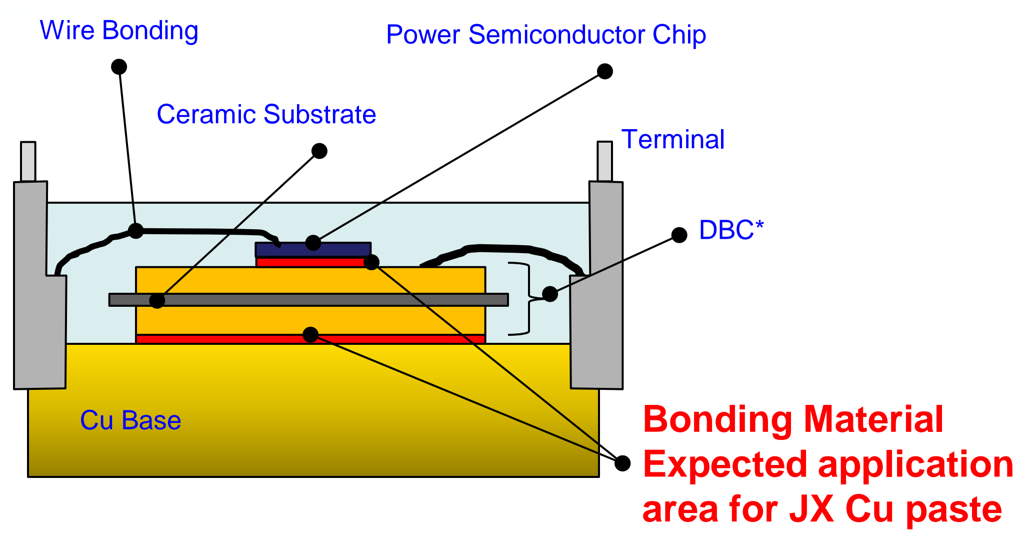
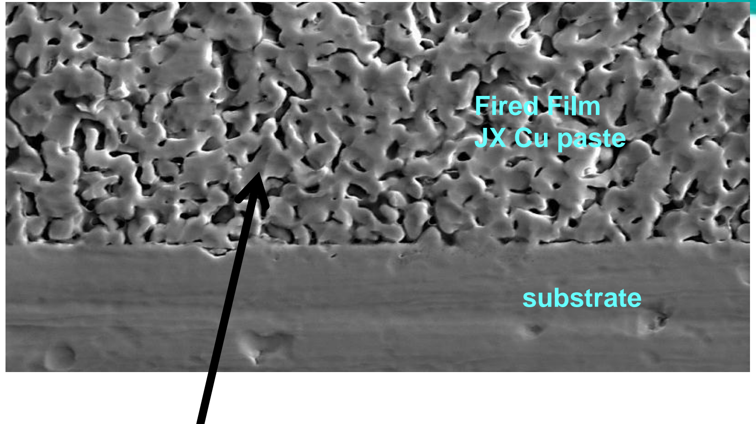
Low Temperature Sintering Type

Example Application for low temperature type : Die bonding for power module



Structure of Power Module



This network structure can affect to relax thermal stress

Advantages of JX Fine Cu Powder and Paste

◆High shear strength can be obtained when applied for Die-Bonding of power module.

◆JX Cu Paste used for die-bonding of power module can show high reliability, because of lower risk of electro-migration compared with that of Ag.

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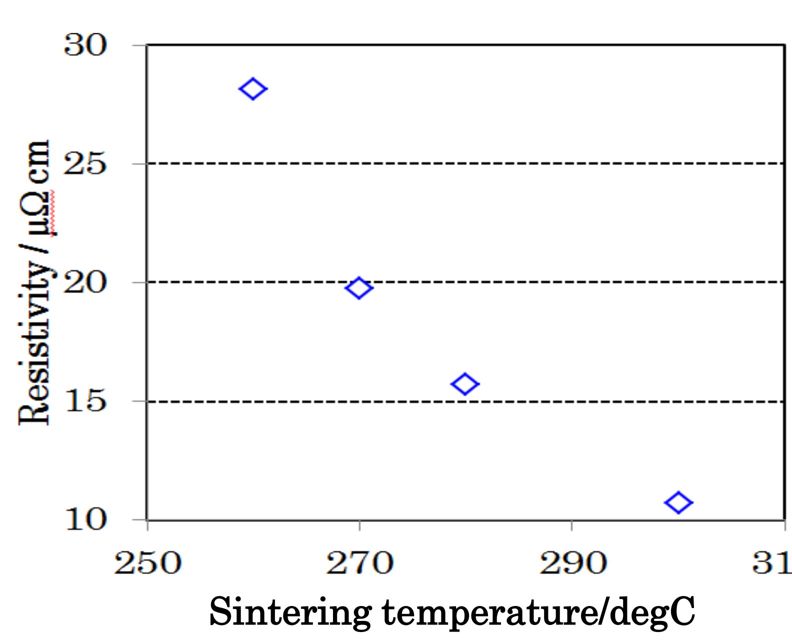
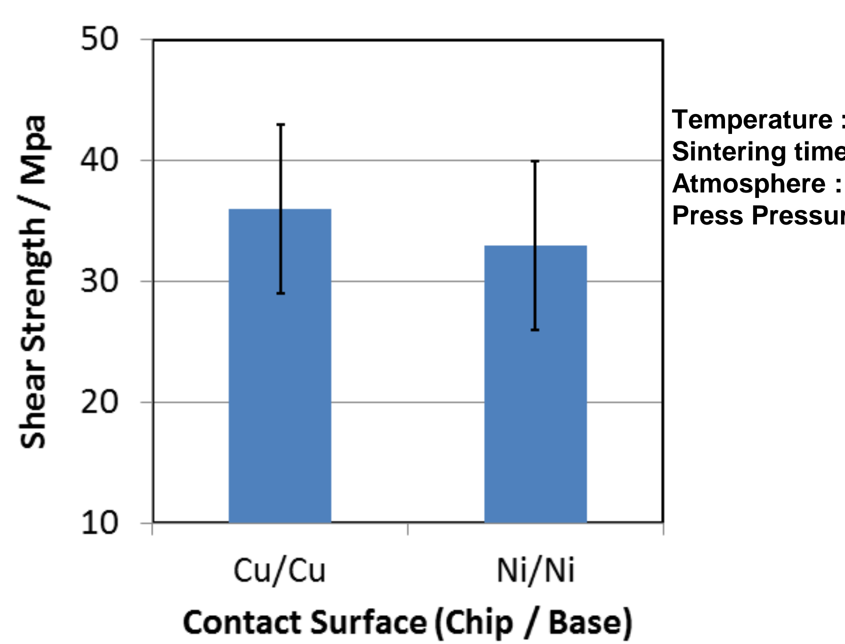
Properties of Low-Temperature Sintering type



Sintering temperature vs. resistivity



Contact Surface Material vs. Shear Strength

- **Shear strength of ≧ 20MPa is obtained by sintering at 300 degC,1MPa pressure, and under reducing atmosphere.**
- **Sintered film shows low resistivity below 10uΩcm.**

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Bonding Test [test conditions]

【Paste Composition】
Binder resin : Thermoplastic resin
Solvent : Alcohol type solvent
Glass frits : not involved

SiC Chip
JX Cu Paste
Lead Frame

Sintering Condition
- Temp. : 300degC
- Sintering time : 1hr
- Atmosphere : Formic acid+N2
- Press Pressure : 1MPa

Paste preparation using Low-Temp. type Cu Powder → Bonding SiC chip on Cu Lead frame → Sintering

Shear Strength >20MPa
Thermal Resistivity＜0.8K/W

High-temperature keeping test
Temperature cycle test
Power cycling test

Image of Package for evaluation (TO-247)

Durability test ← Packaging ← Evaluation of basic properties

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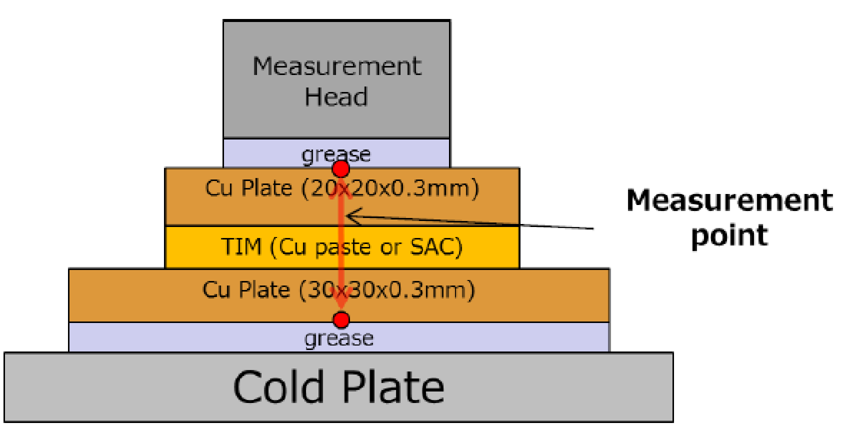
Results of thermal resistivity measurement



Material	SAC (0.06mmt)	Cu Paste (0.088mmt) *Sintered Cu @300 degree
Thermal Resistivity (deg/W)	0.13	**0.05**
Thermal Conductivity (W/m･K)	55	**190** (*1)

***1: calculated from structure function.**

Compared to SAC solder, the thermal resistivity and conductivity of Cu paste are approximately 40% (60% reduction) and 3.5 times respectively.

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Bonding test result for wide area

Process:350 degree C 3min.
15MPa

20mm

Top View by CT

SU70 6.0kV 15.1mm x300 PDBSE(CP) 100um

SU70 6.0kV 15.5mm x300 PDBSE(CP) 100um

SU70 6.0kV 15.0mm x10.0k PDBSE(CP) 5.00um

Uniform Cu film can be obtained for relatively wide area of 20mm□

SU70 6.0kV 15.8mm x10.0k PDBSE(CP) 5.00um

Cross Sectional View for Centre Area by SEM

Cross Sectional View for Edge Area by SEM

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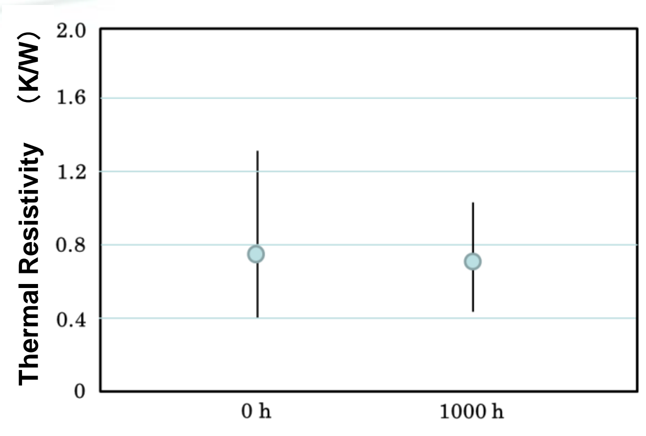
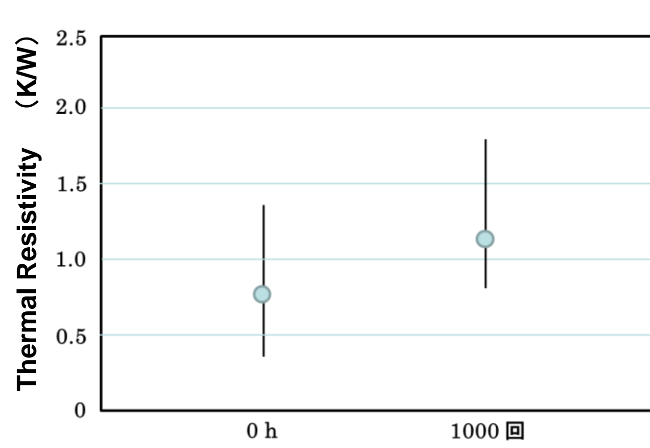
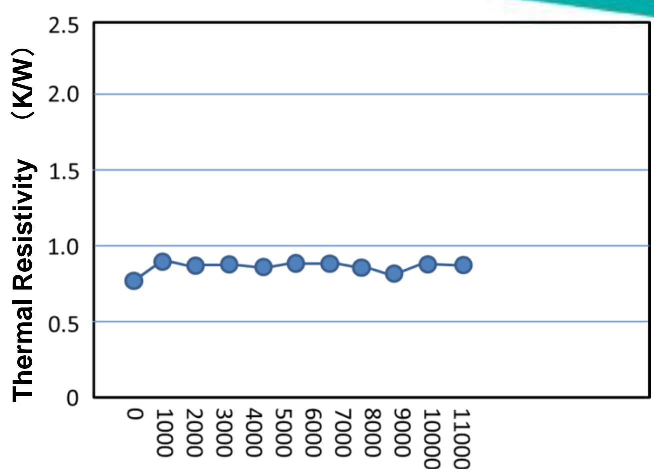
Bonding Test [durability test results*]







- High-Temperature Keeping test (@ 250degC,1000hr)
  → Thermal resistivity did not change.
- Temperature Cycling test (@-50/250degC)
  → Increase of Thermal resistivity was about 50% after 1,000 cycle.
- Power Cycling test (@Tjmax=175degC,Delta-Tj=150degC)
  → Confirmed the proper operation of SiC chip after 10,000 cycle.

*Experiments were performed by WBG consortium

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