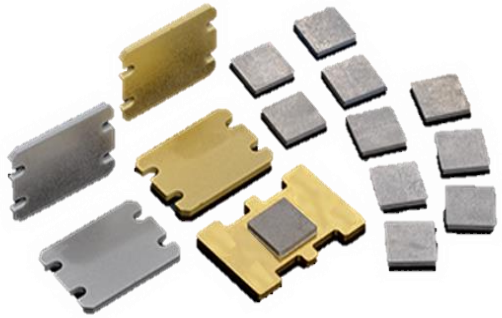
A.L.M.T. Corp.

SUMITOMO ELECTRIC U.S.A., INC.

New composite material of Silver and Diamond for high-performance device



Bill Ishii

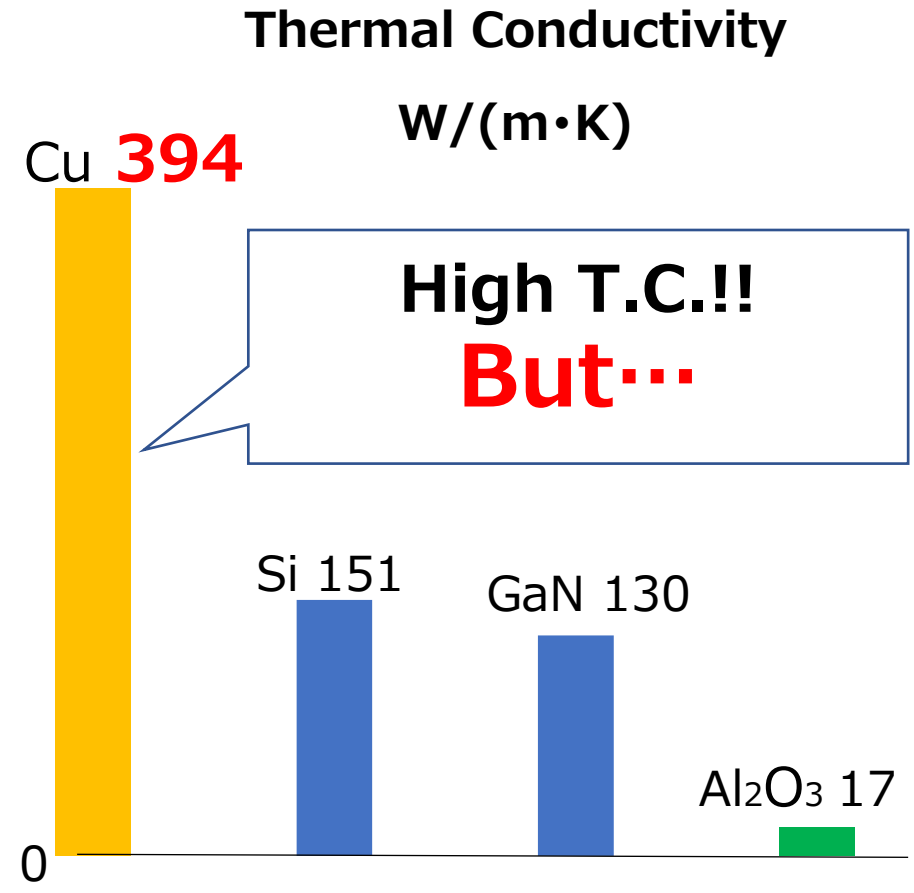
Apr, 2023

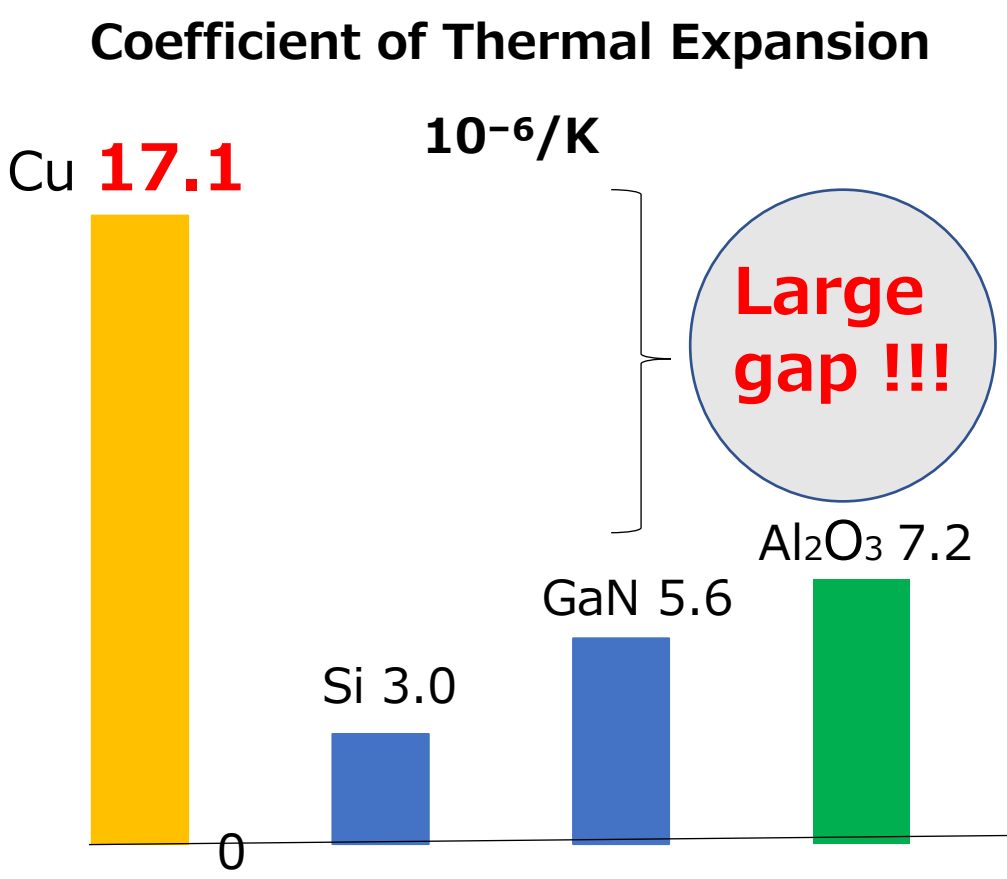
Sumitomo Electric U.S.A., Inc.

SUMITOMO ELECTRIC GROUP

The importance of thermal management for power devices

As power devices get more and more advanced, they generate excess heat and thus require thermal management.



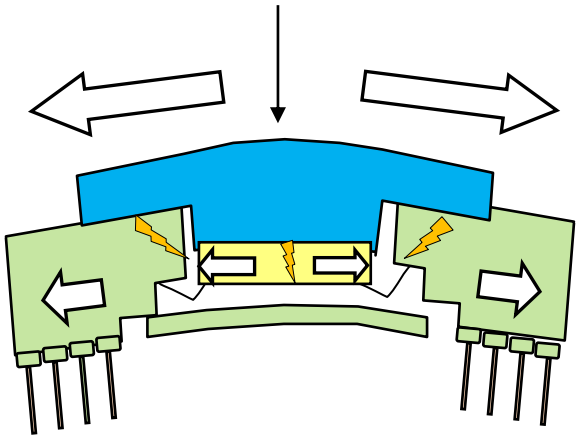


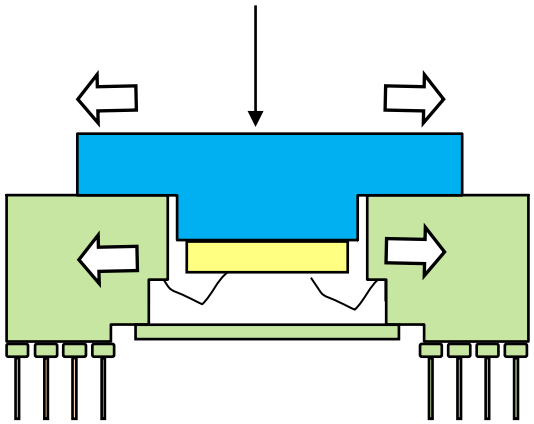
Demonstration of heatspreder

Copper Heatspreader
(CTE:17.1)

Al_2O_3
(CTE: **7.2**)

Ag-Diamond Heatspreader
(CTE:9.5)





If CTE Doesn't match with package and chip
→ CRACK OCCURS.

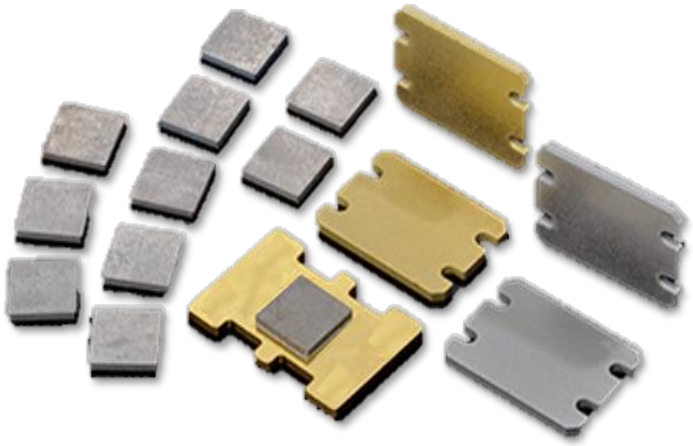
If CTE Matches with package and chip
→ NO CRACK!

Ag-Diamond (AD90)

- High and Stable Thermal Conductivity!

  ＞600W/(m･K)

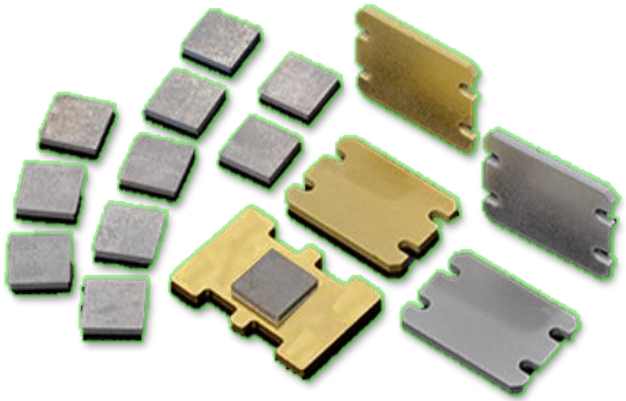
- Available with Ni and Ni/Au plating



- Suitable for Ag-Brazing (780℃)

Properties (Typical)

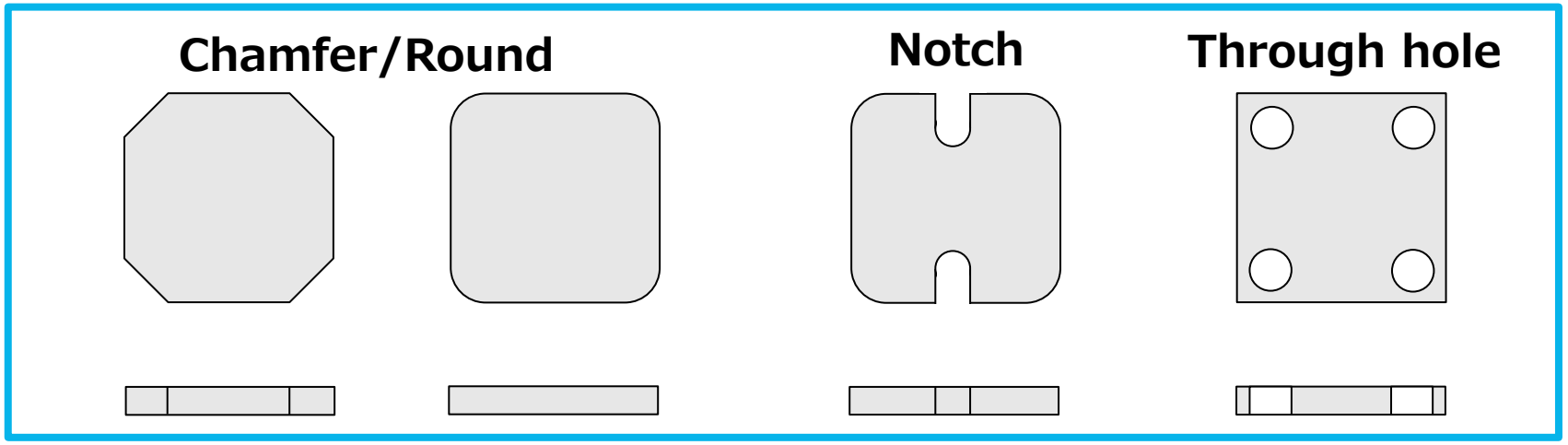
Thermal Conductivity (TC)		>600 W/(m·K)
Coefficient of Thermal Expansion (CTE)	RT~400℃	9.5 x 10-⁶/K
	RT~800℃	11.2x 10-⁶/K
TC (after heat-treatment at 800℃)		No change
Specific Gravity		5.9
Specific Heat		0.34 kJ / kg·K
Young's Modulus		346 GPa
Poisson's Ratio		0.24



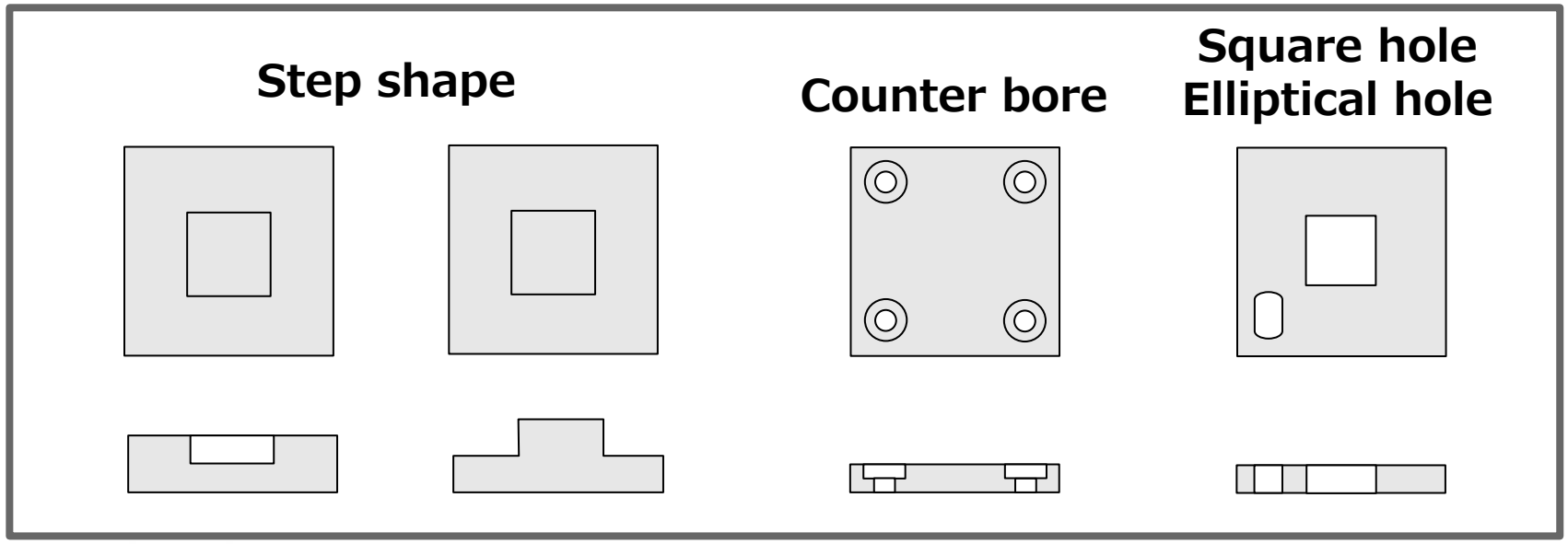
Thickness (mm)	Dimension (mm)	Surface Roughness	Sharp Edge	General Tolerance (mm)	Plating
0.2~2.0	50 sq. max	Ra 1.2μm	N/A (Under development)	+/- 0.05	・Ni ・Ni/Au

Product shape

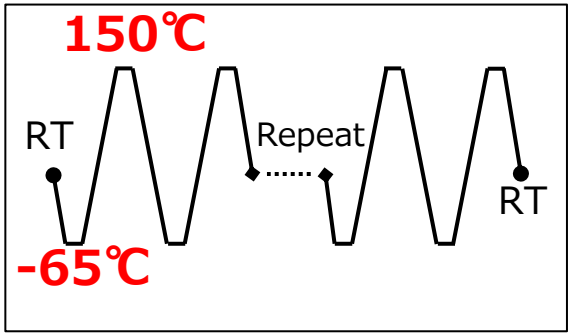
Available



Not available

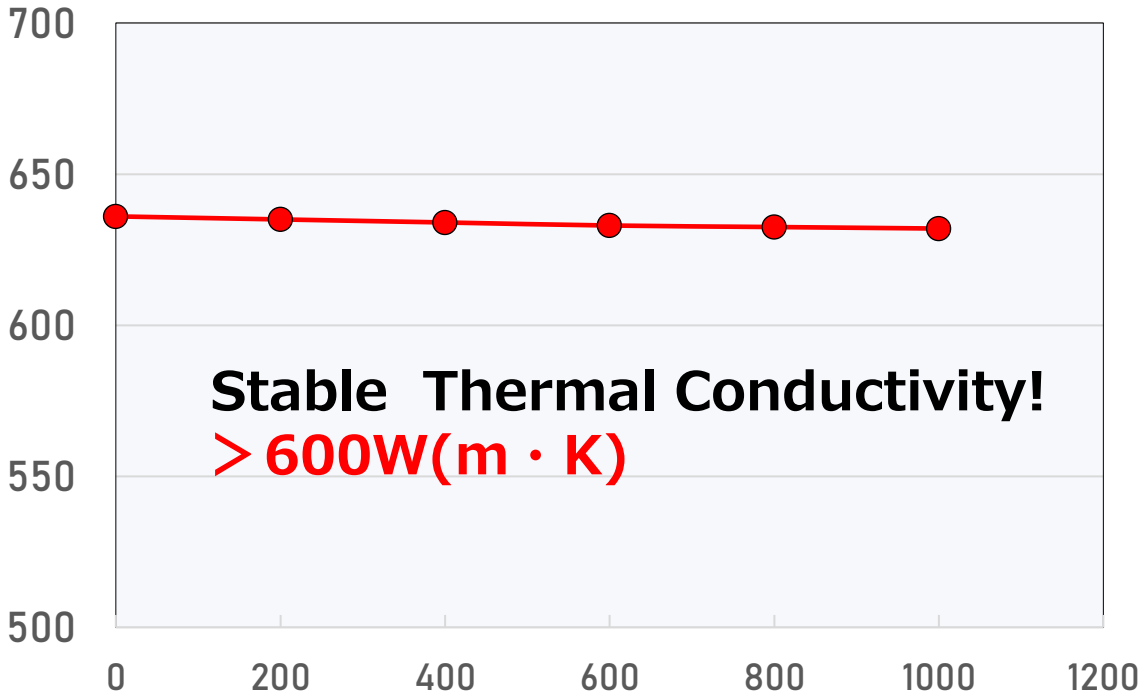


High Reliability



Thermal Shock condition
(Liquid bath)

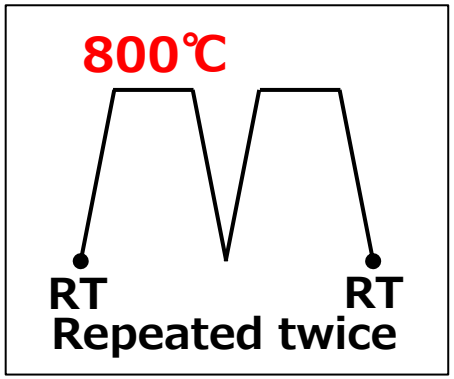
Decreasing of Thermal Conductivity



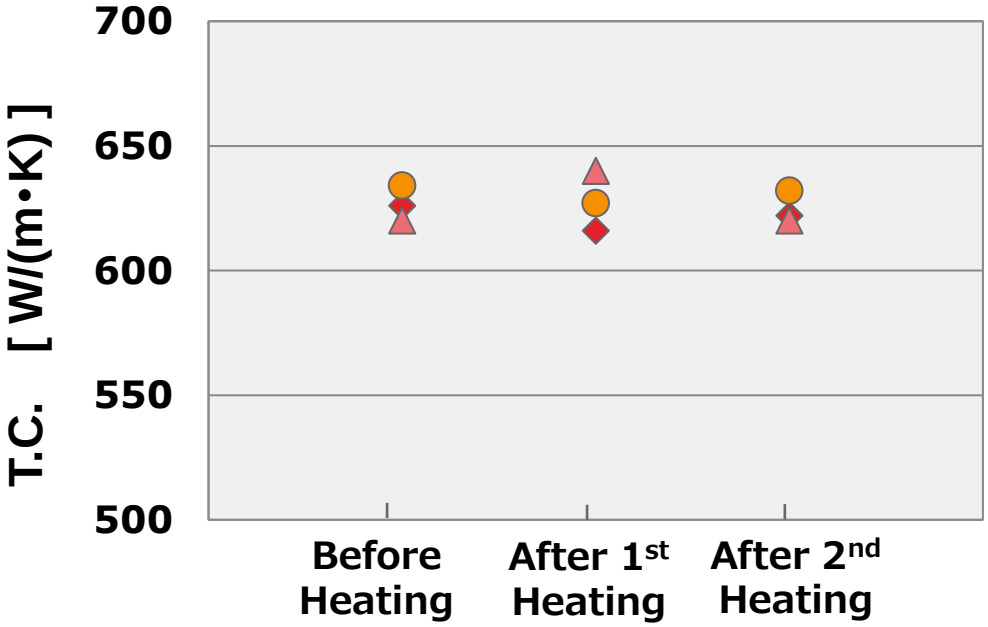
T.C. maintains over 600 W/(m·K)
even after 1000 times heat-cycles test.

Ag Brazing Assembly

Influence of Heat Treatment (800℃)

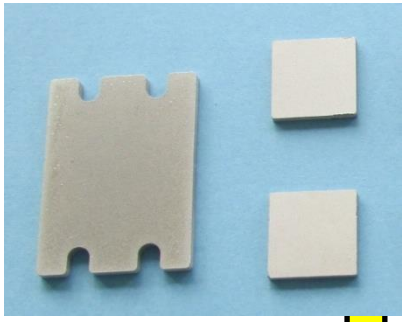


Heating Condition



Assembly of Ceramics Package

Ag-Diamond base plate



+ Ceramics Lead

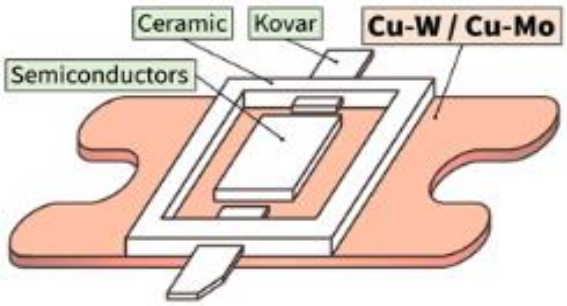
↓

Ag Brazing (780℃)

↓

Ni/Au plating

↓



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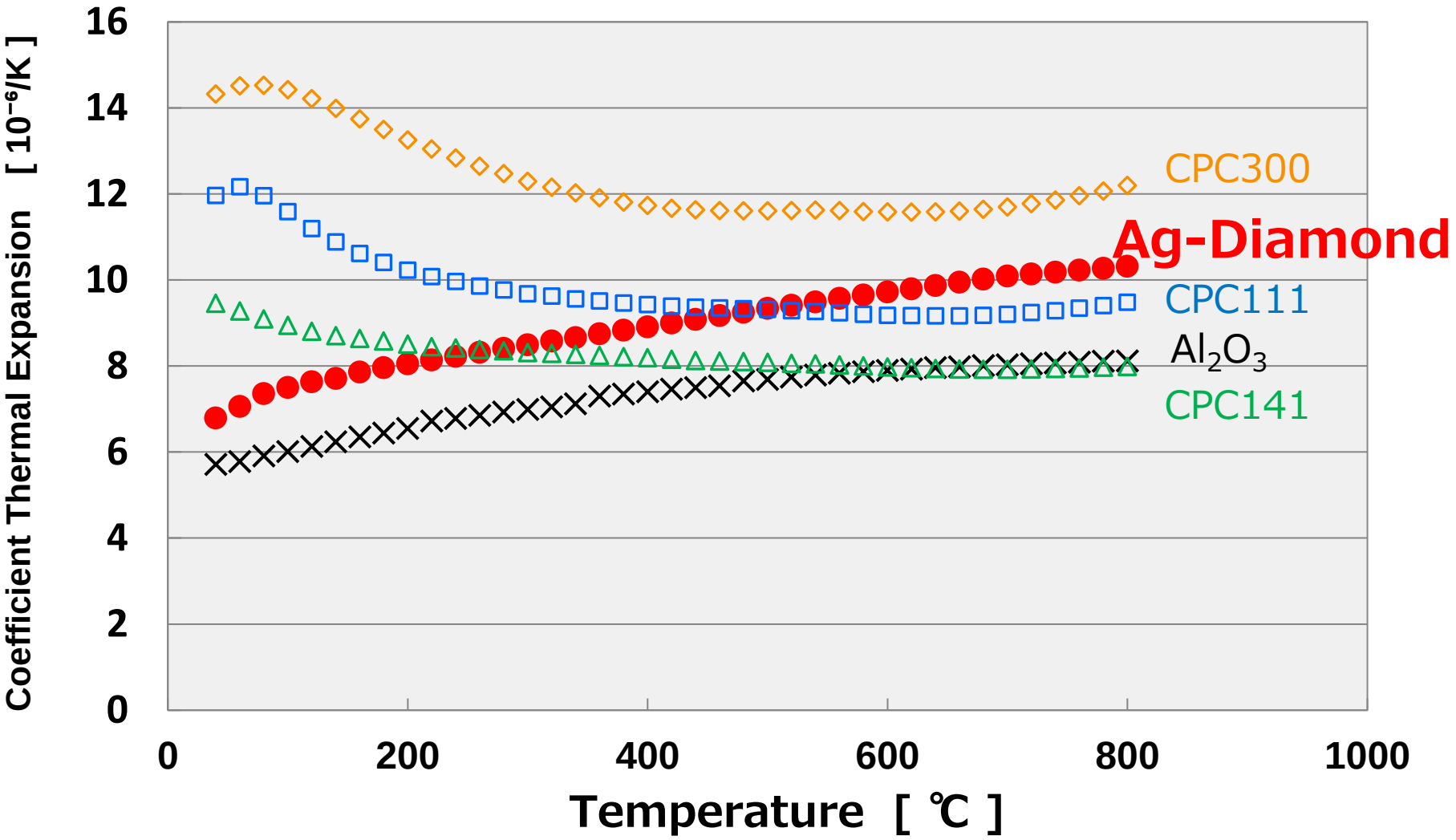
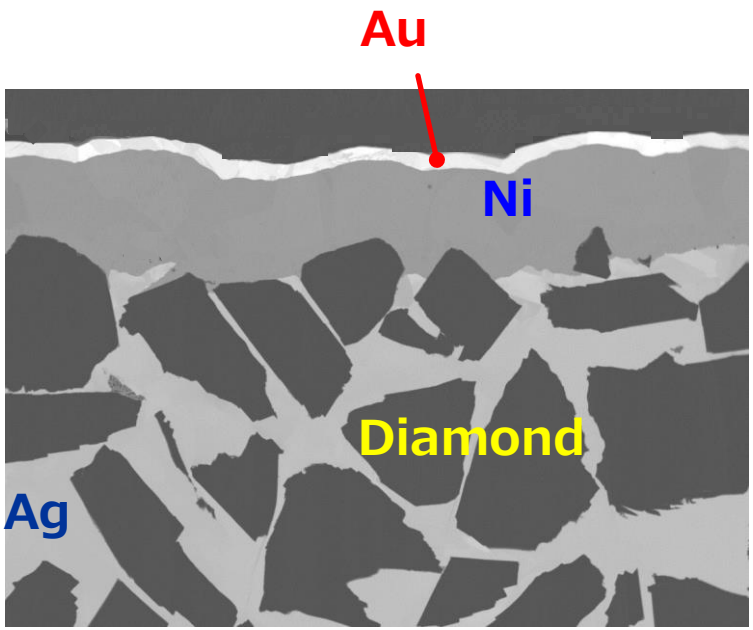
Temperature Dependence of C.T.E.



CPC … A composite material (copper, copper-molybdenum, copper)

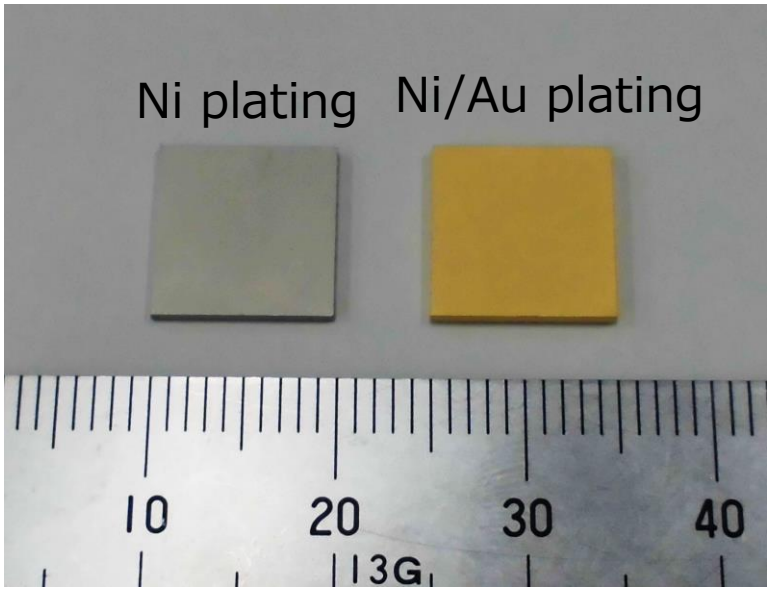
Plating Properties

1. Cross section after Ni/Au plating



Good adhesion!!

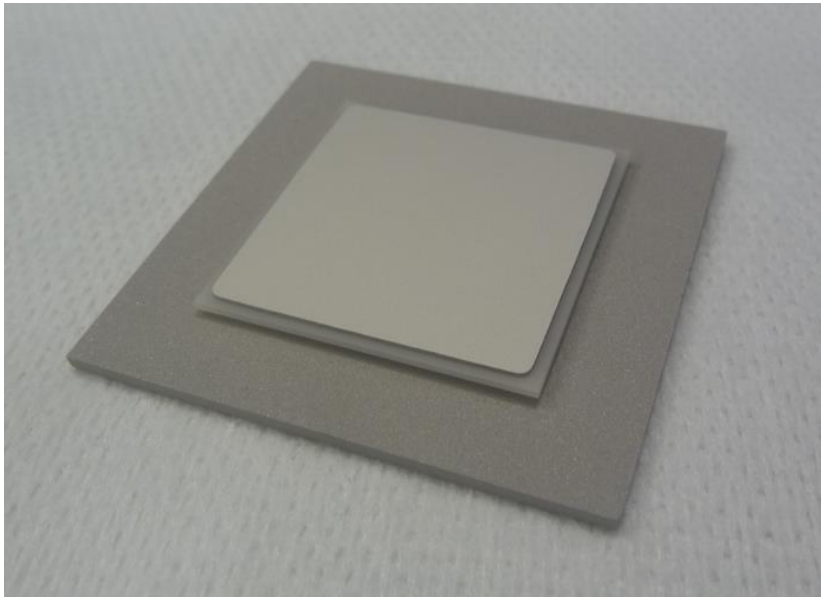
2. Appearance after heat treatment



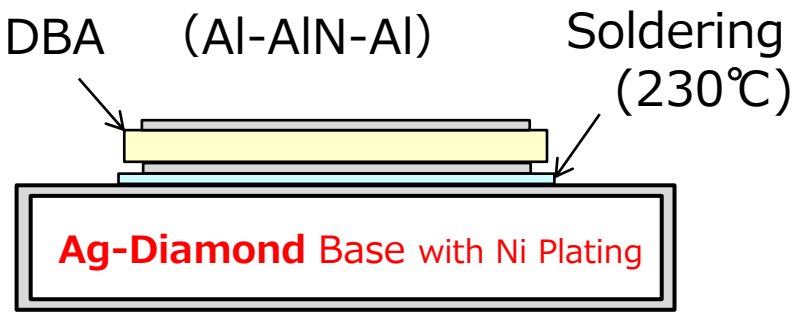
No blisters at 800℃ (Ni) and 400℃ (Ni/Au)

Assembled Samples

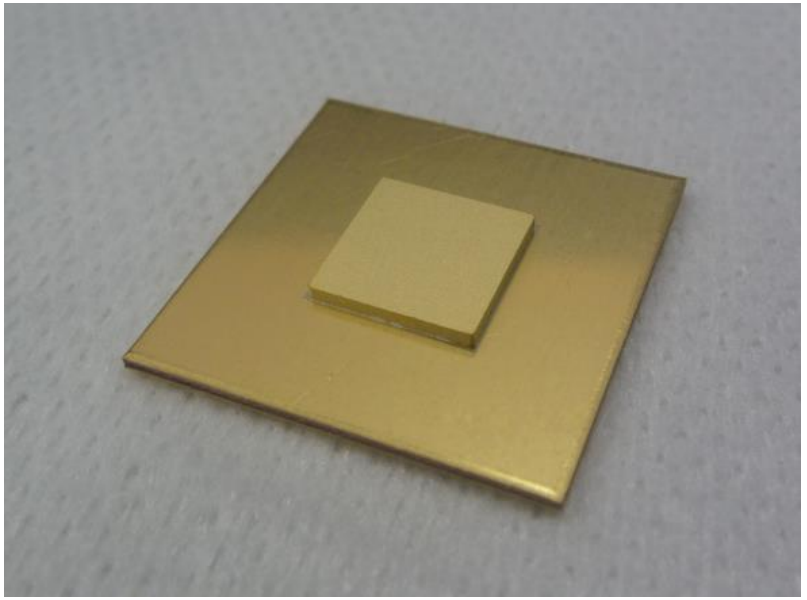
For Automobile



<Cross Section>

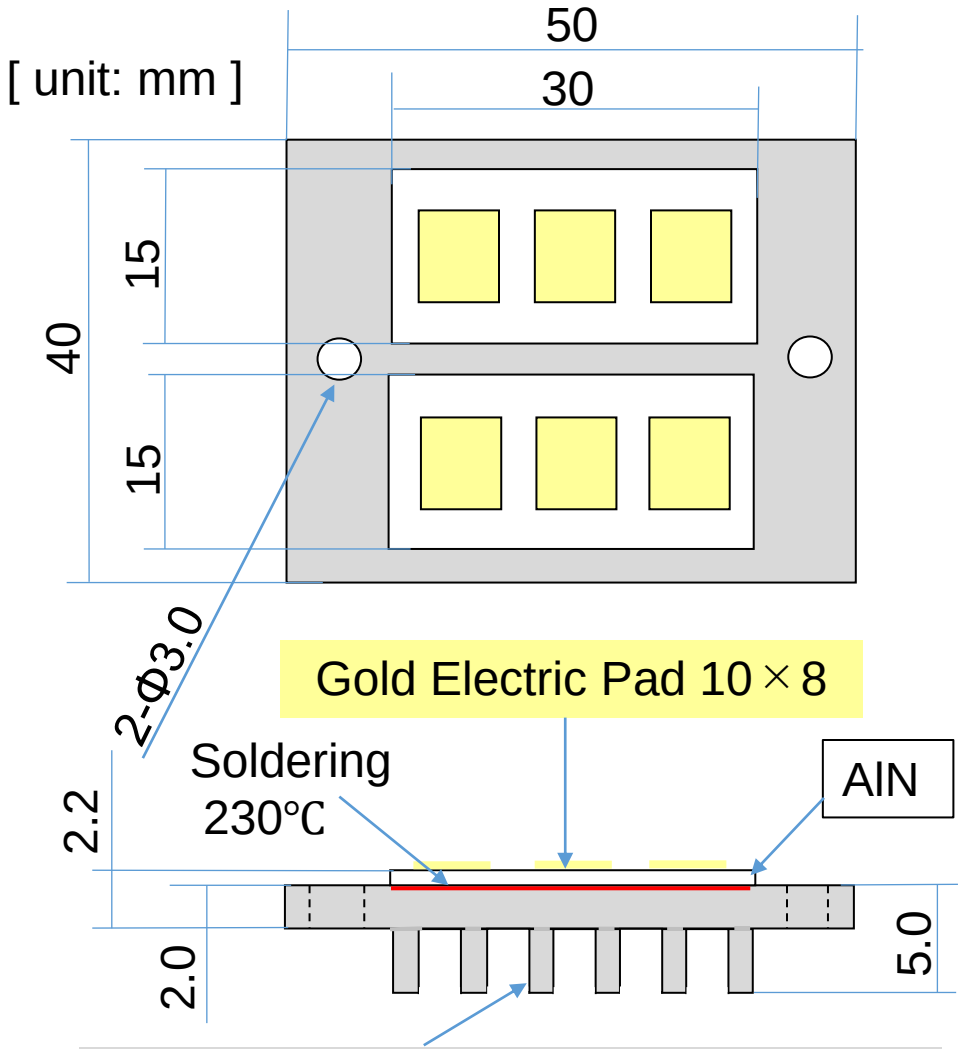


For Wireless Communication

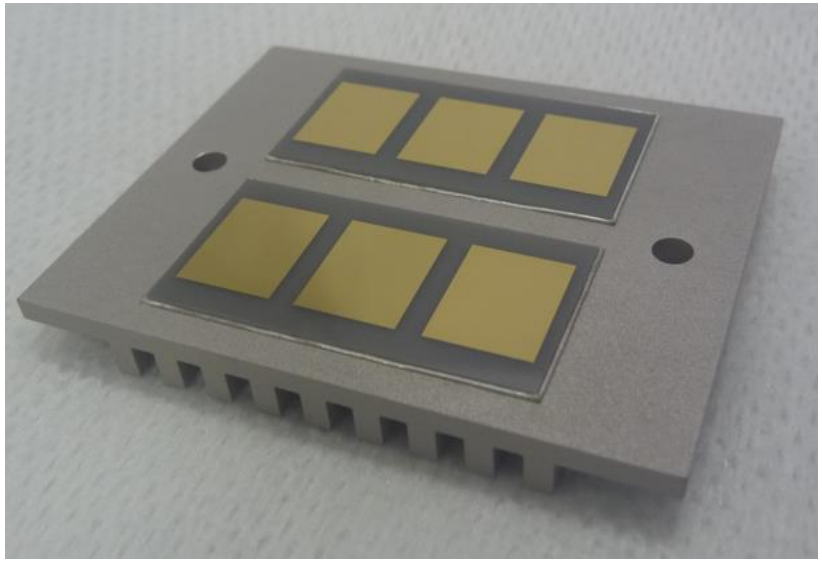


<Cross Section>

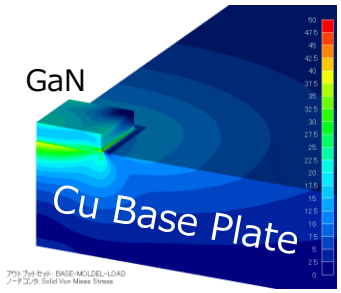
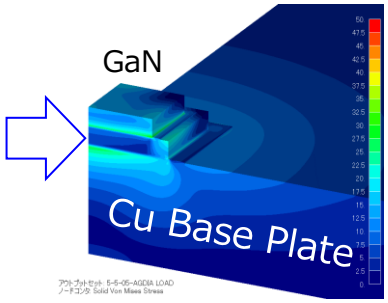
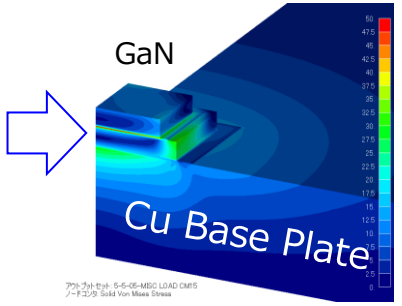
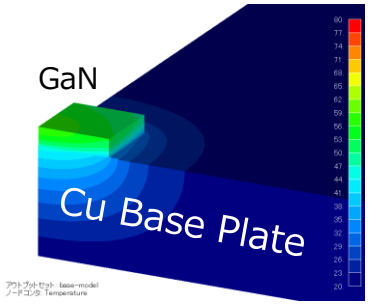
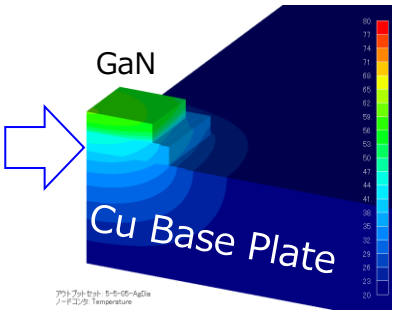
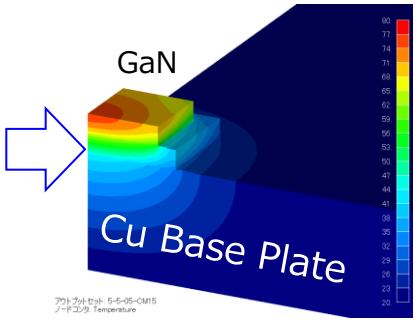
Sample for Power device (for Automobile)



For Automobile



Comparison of Thermal Stress and Temperature on GaN chip

	Cu Base Model (No Chip Carrier)	With Ag-Diamond Chip Carrier	With Cu-Mo Chip Carrier
Thermal Stress of GaN Chip	39.0 MPa 	30.7 MPa 	31.8MPa 
Temperature on GaN chip	57.7 ℃ 	59.1 ℃ 	75.5 ℃ 

Summary

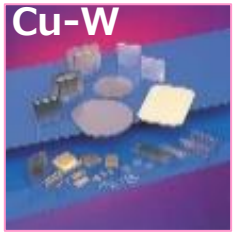
- As power devices are getting more advanced, thermal management is becoming more important.

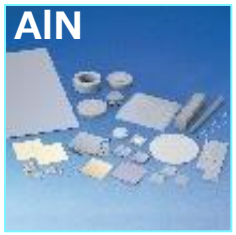
- Ag-Diamond is an excellent material for applications requirements that can benefit from:
  - ✓ TC is more than 600W/(m·K)
  - ✓ Stable TC after heat-cycle
  - ✓ Ni and Ni/Au plating are available
  - ✓ Ag-Brazing (780℃) is available
- The heatspreader can be assembled with isolated plating and/or popular metals.
- Your device can now reach even greater potential, with Ag-Diamond!

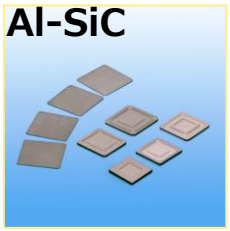
For more detailed information or technical data, ask Bill Ishii (bishii@sumitomo.com)

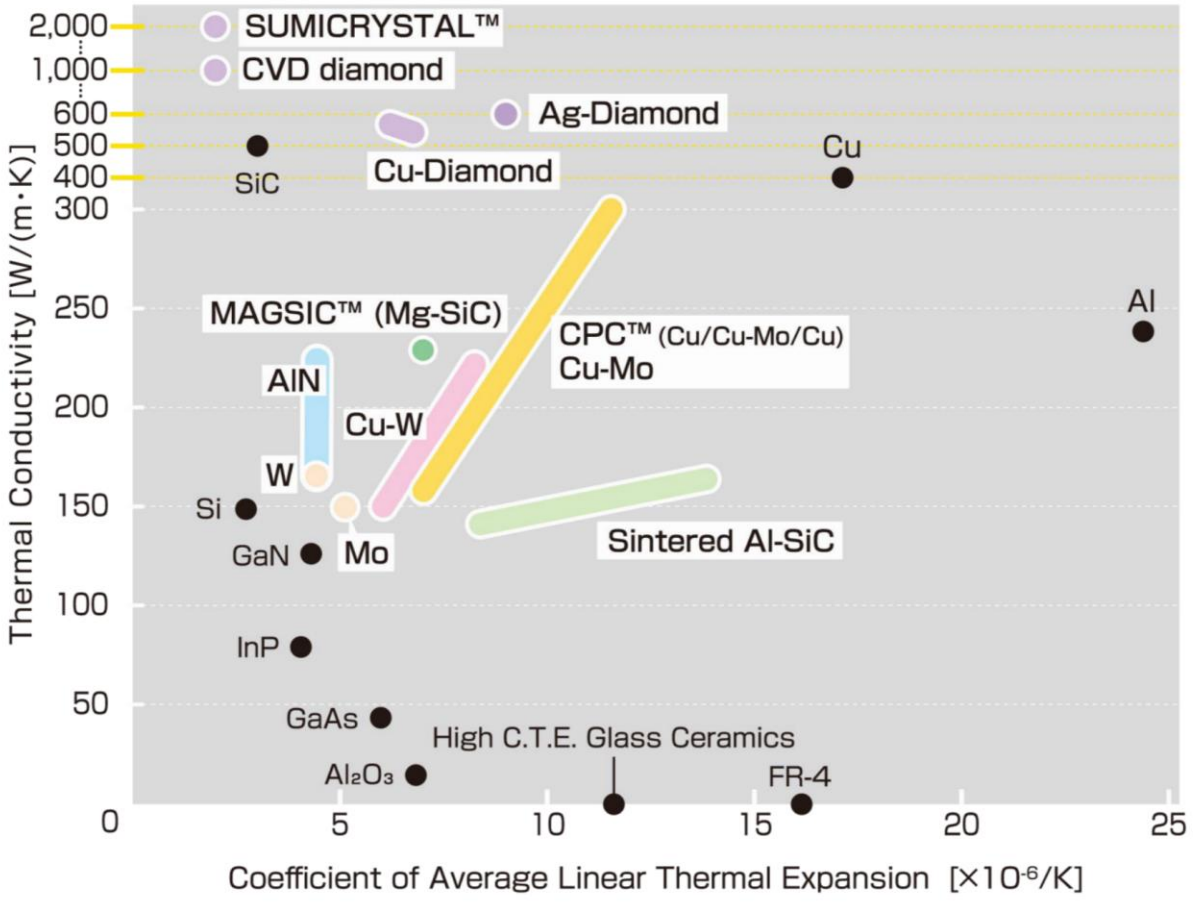
A little introduction about us

In addition to Ag-Diamond, we are manufacturing many kinds of heatspreaders for various fields.









SUMITOMO ELECTRIC U.S.A., INC.

Thank You

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