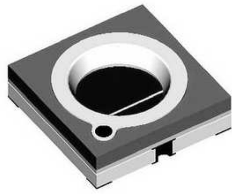


Ceramic LED PKG

1. Features of Ceramic LED PKG

- Compactness (Small, Low profile)
- High Reliability
- Good Thermal Properties
- Surface Mountable
- Pb Free (RoHS Compliant)
- Design can be changed easily
  - Module type available

Comparison of Material characteristics of Ceramic and Resin (PPA)

	Thermal Conductivity	Thermal Expansion Coefficient	Size	Cost	Dimension Accuracy
Ceramic					
PPA					

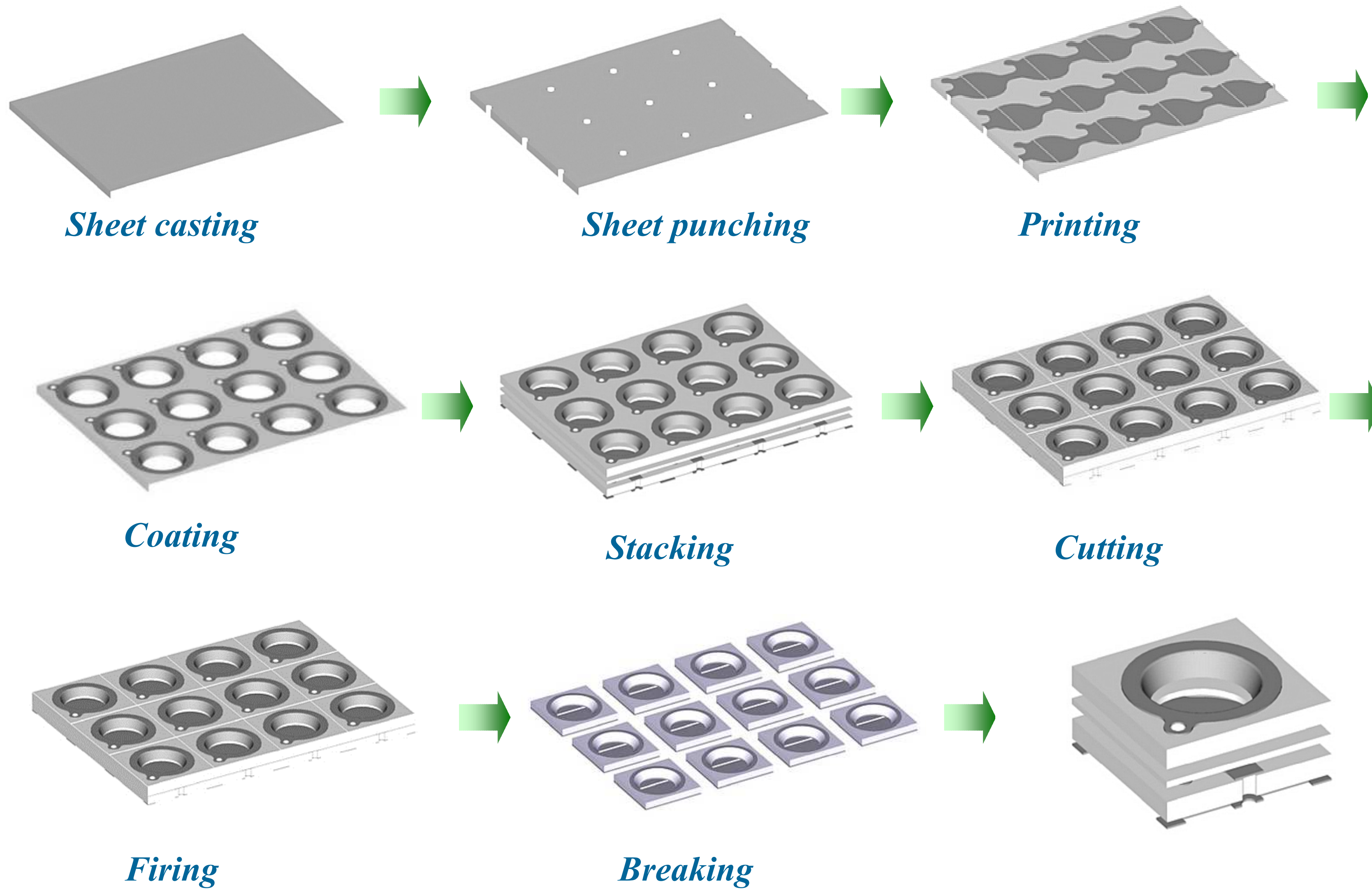
2. Ceramic Material Properties

	Ceramic	PPA
Color	White	White
Dielectric Constant	7~8	3.68
Thermal Conductivity (W/mK)	2~4	0.47
	> 50 (with thermal via, Ag)*	
Thermal Expansion Coefficient (CTE)	5~6(x10^{-6}/K)	10~25x10^{-6} /K
Mechanical Strength	> 200MPa	> 190MPa
Specific gravity	3.0±0.5	1.58

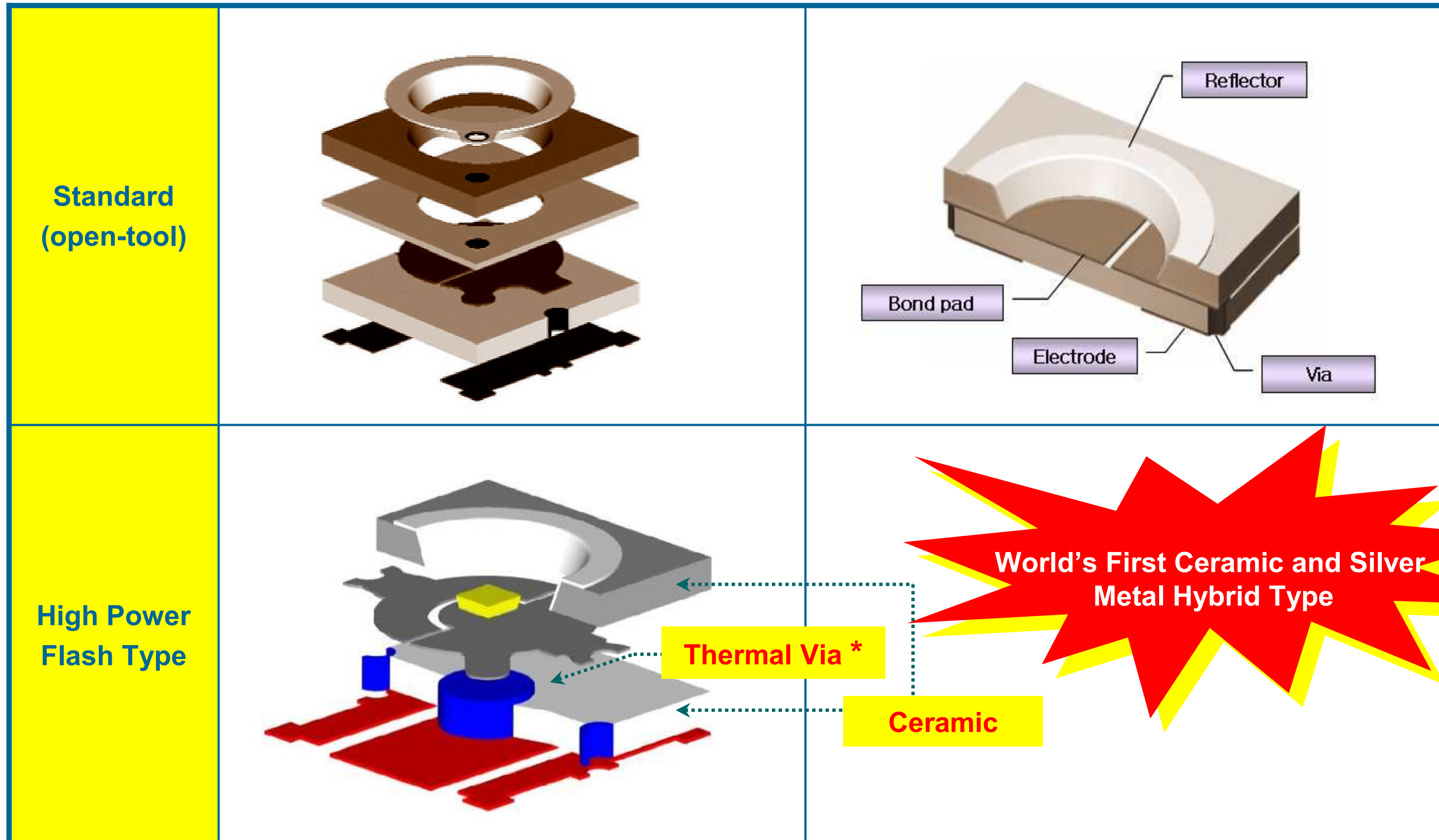
-. The above values are typical values.

* In case of thermal conductivity, the value can vary by the design of LED PKG with thermal via.
(50~max. 400 W/mK, refer to Appendix of this Brochure)

3. Manufacturing Process



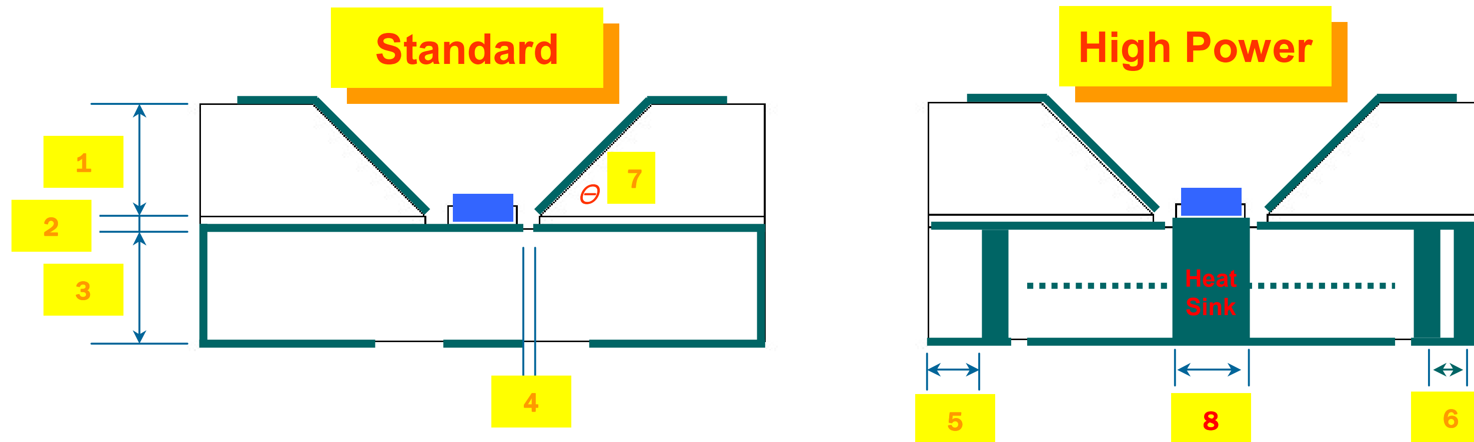
4. Exploded Diagram



* Thermal Via Diameter : 1.5~2.0mm (5x5 size), the larger thermal via diameter is possible (PKG size consideration)

-. The material of electrode, reflector, via and thermal via is pure silver(Ag).

5. Design Rule

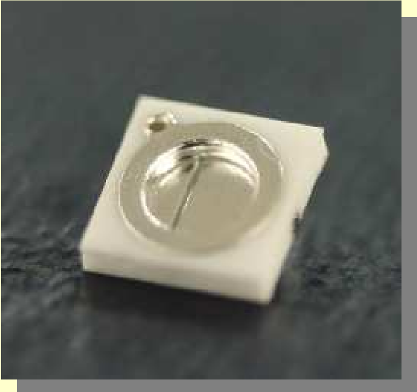


		Typical	Special
1	A Block	Customer (>14mil)	12mil
2	B Block	2~4mil	-
3	C Block	Customer (>14mil)	12mil
4	PAD Spacing	> 8mil	4mil
5	Internal via to part etch	10mil	5mil
6	Via pitch (Thermal via)	3x Via Dia	1.8x Via Dia
7	Cavity angle (ϴ)	60~90 degree	50 degree
8	Internal via diameter	8~80mil (Heat Sink, 5x5 size)	> 80mil possible (PKG Size Consideration)

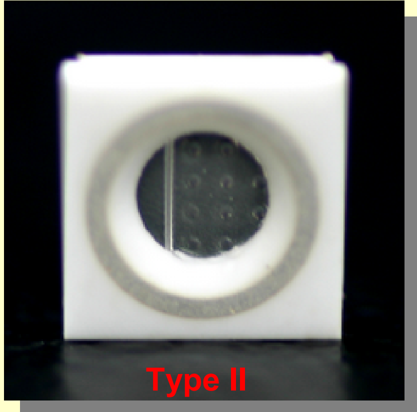
6. Figure of PKG

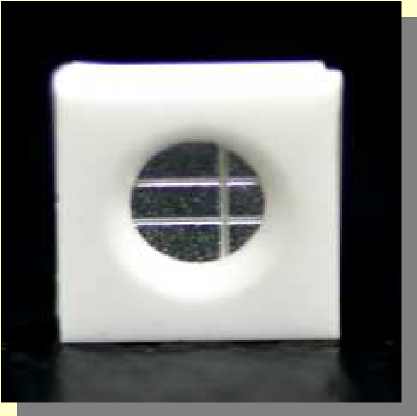
Standard

High Power



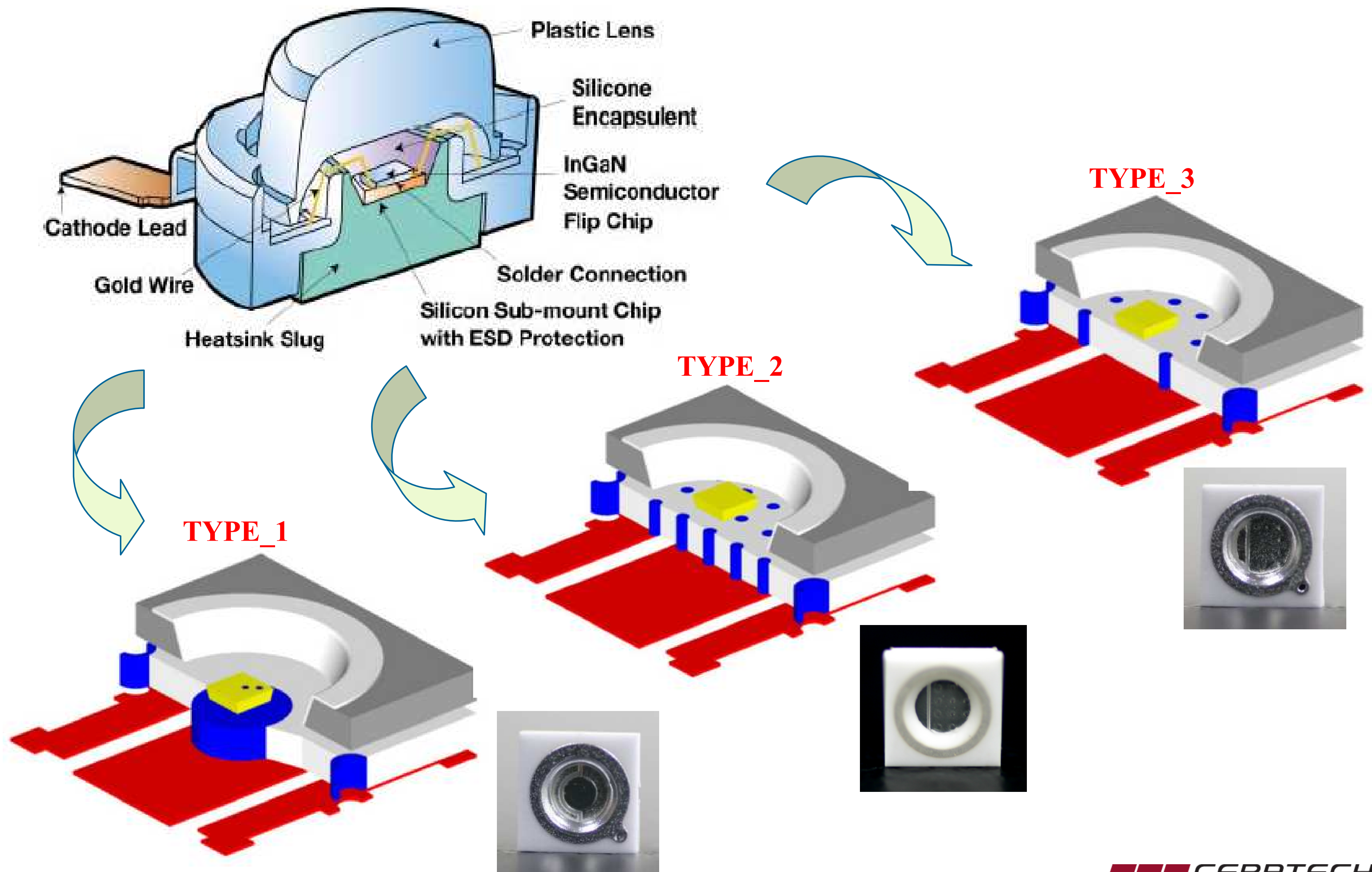
Type I


Type II



Type III

High Power PKG



7. Open-Tool Dimension

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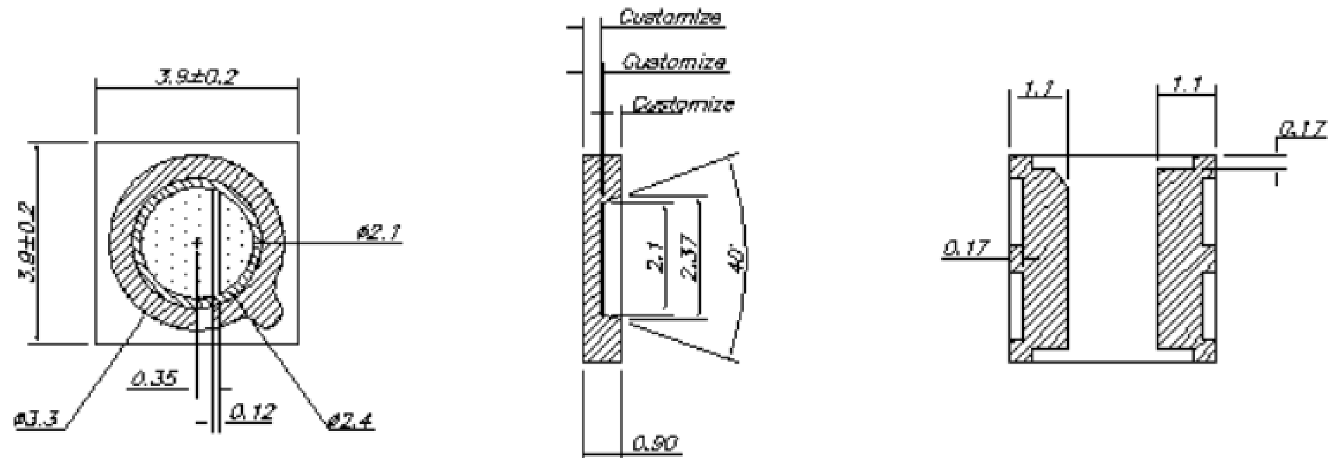
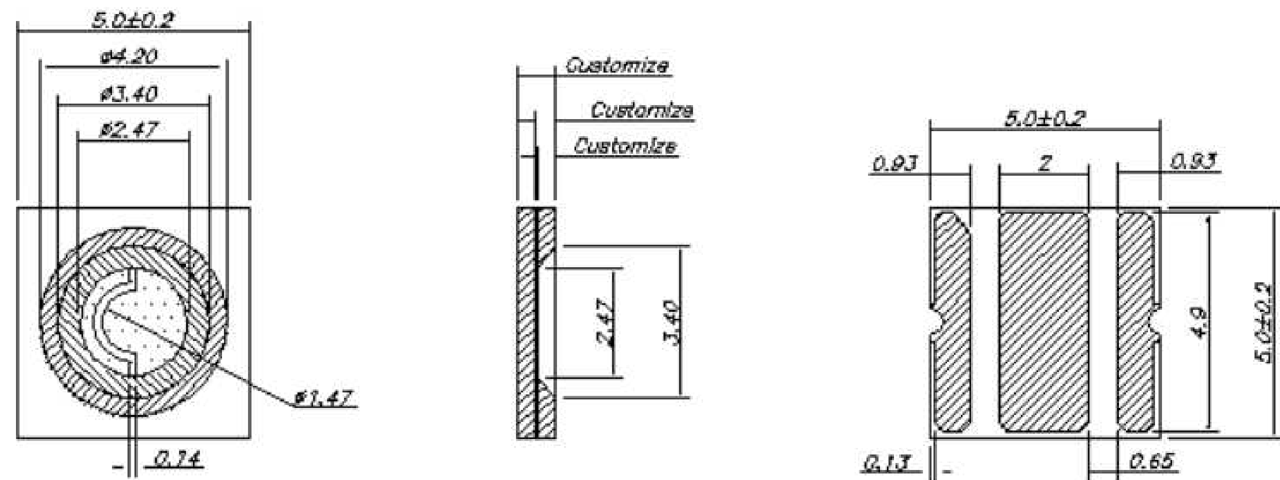
<td>
</td>
</tr>
<tr>
<td>5x5 Size</td>
<td>
</td>
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8. Reliability Test

Item	Test Condition	Requirement	No	Result
Vibration	Frequency : 41→ 55→ 10Hz Direction : x, y, z Time : 2hr	No Mechanical Damage Inspect with Scope	10ea	OK
Thermal Shock	100 cycle (-40℃*20min → 85℃ *20min)	No Mechanical Damage Inspect with Scope	10ea	OK
Reflow Soldering	Preheat Temp : 150℃ Preheat Time : 1min. Solder Temp : 230±10℃ Soldering Time : 10sec (max.)	Inspect with Scope	10ea	OK
Wire Bondability	Au Wire Temp 160℃ (Au Wire 1mil)	Pull Strength : >3gr	10ea	OK

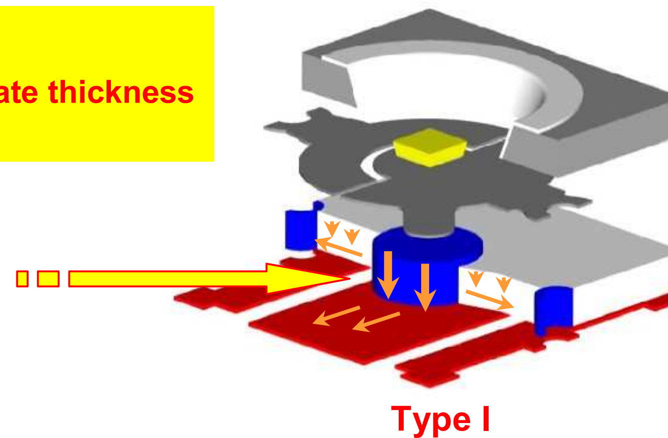
9. Thermal Analysis

Thermal Resistance of various products

Product	Rth (only PKG, T3Ster)	Remark
Ceratech Type I (5x5)	5~6K/W	> 1.30K/W*
Ceratech Type II (5x5)	9~10K/W	
Ceratech Type III (5x5)	9~10K/W	
LumiLEDs	4K/W	Same Test Condition

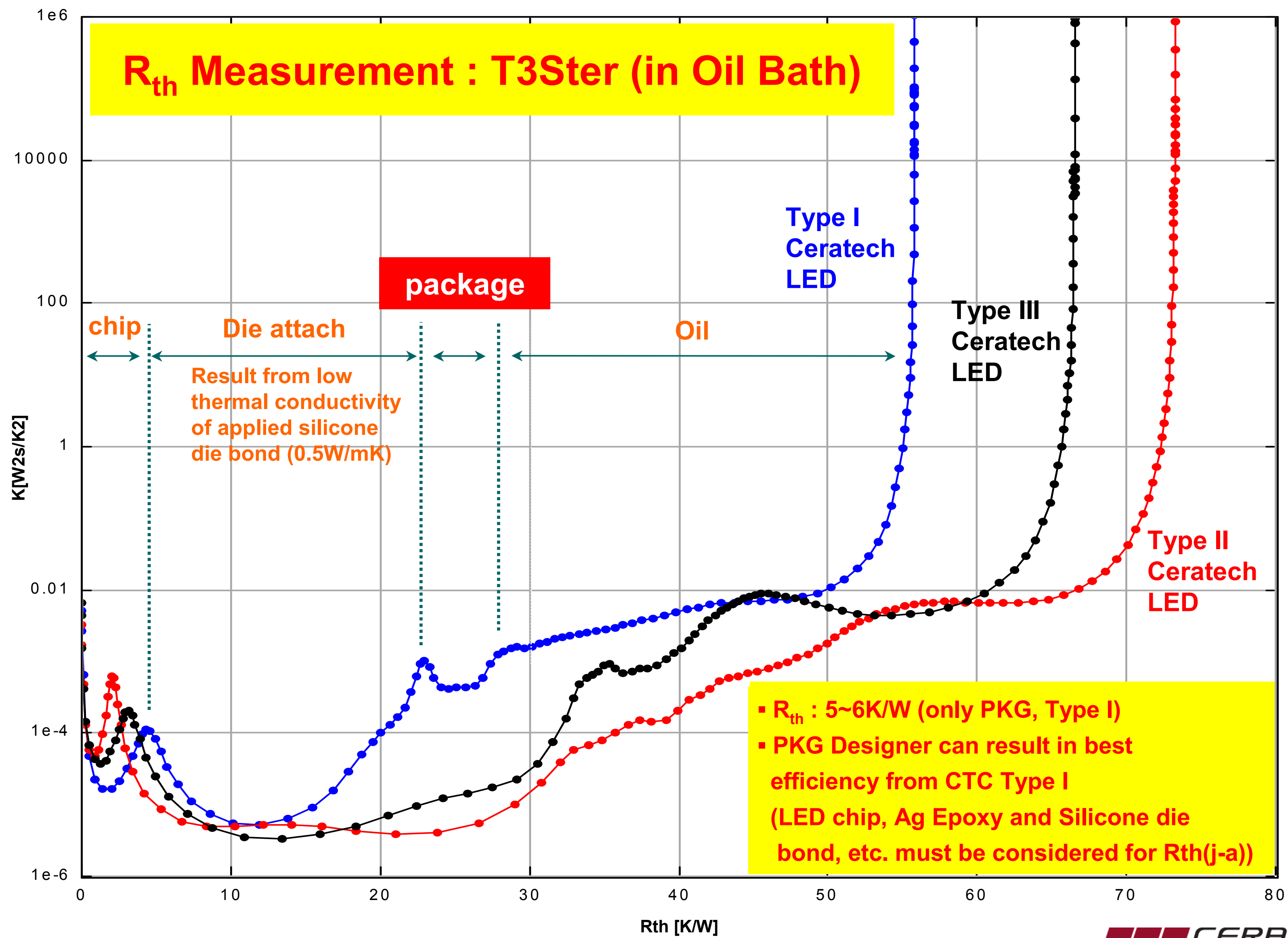
* Calculated value
- resulted from ultra small Substrate thickness (World's Shortest Thermal Path)

$$Rth = \frac{L}{K \cdot A}$$



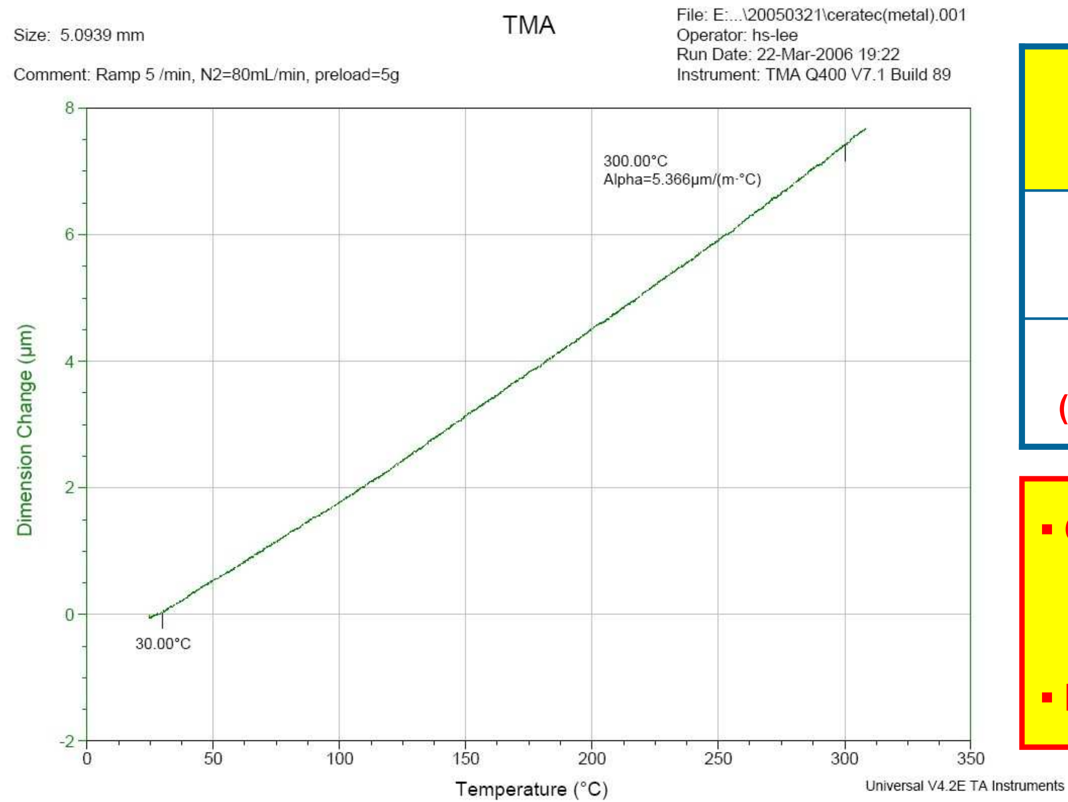
Type I

9. Thermal Analysis



10. Thermal Expansion

TMA Curve (Type I)



TMA Data

	Coefficient of thermal expansion (CTE, $x10^{-6}/K$)
Ceramic Only	5.384
Type I (Ceramic+Metal)	5.366

- CTE of the Type I is very similar to the value of the LED substrate (ex. GaN 5.5ppm)
- Highly Reliable for the Thermal Stress

11. Appendix

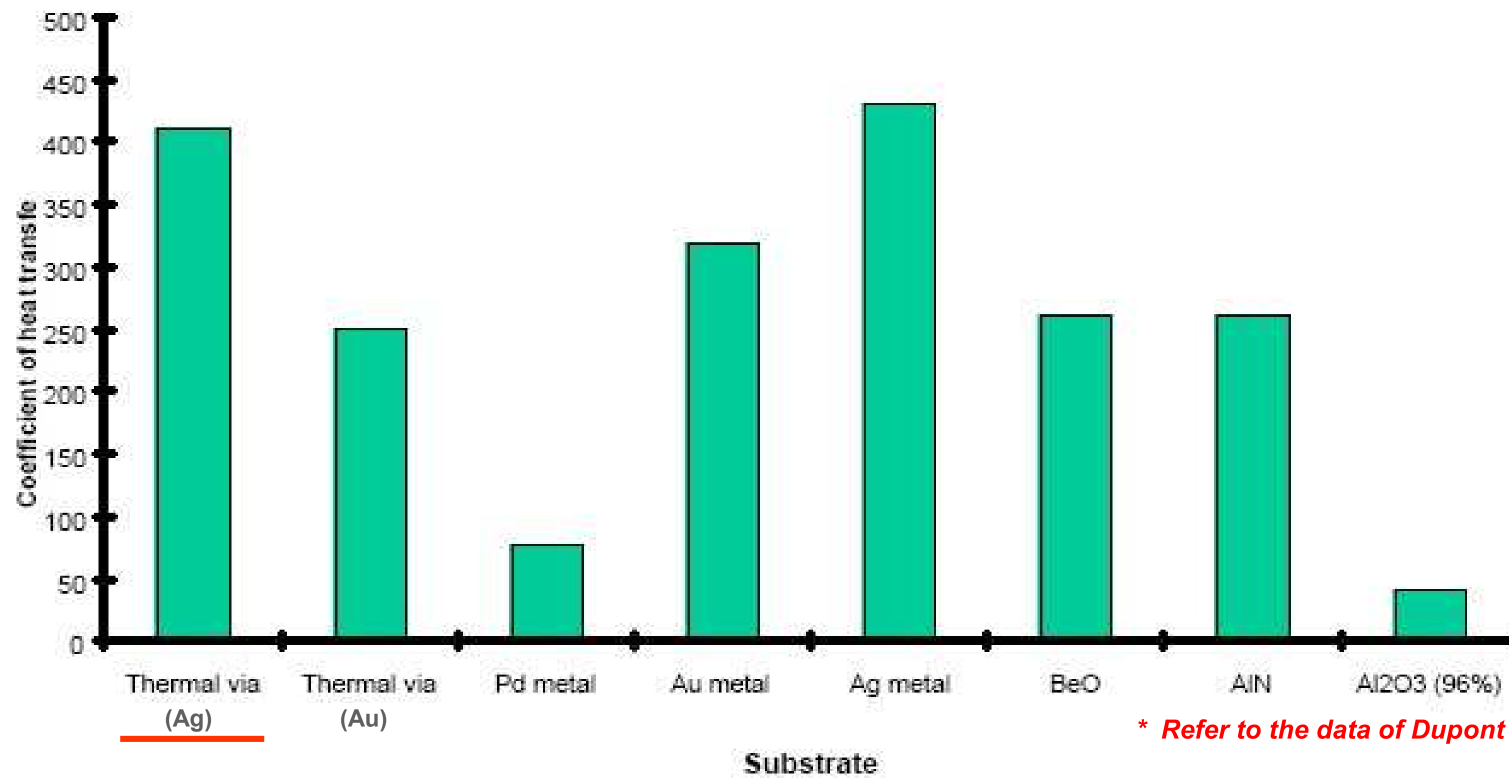
Thermal Via Metal Coverage-sensitivity Study

	Description	Peak Stage Temp. (℃)	Thermal Resistance (℃/W)
A	No Silver Paste-filled thermal via	203.3	34.9
B	25 thermal vias 150㎛ diameter each	96.5	14
C	14 thermal vias 250㎛ diameter each	88.1	12.3
D	Silver-paste filled thermal via Covering 100% the die area	53.1	5.5

Similar to Ceratech Test Data by T3Ster

*. V. A. Chiria, "Thermal Assessment of RF Integrated LTCC FEM", International Society Conference on Thermal Phenomena, 520~527 (2002)

Thermal Conductivity of various materials



* *Refer to the data of Dupont*