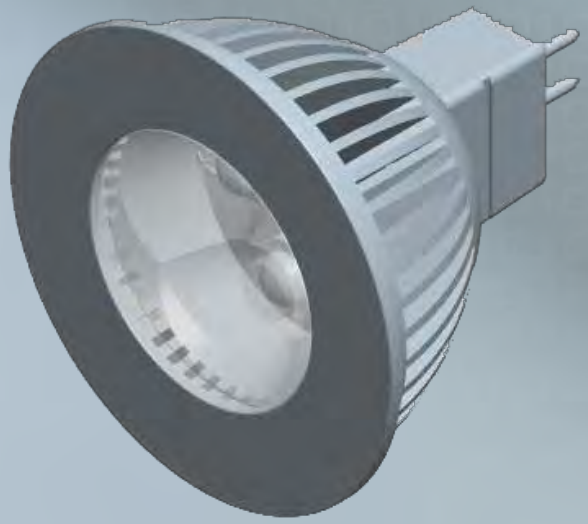
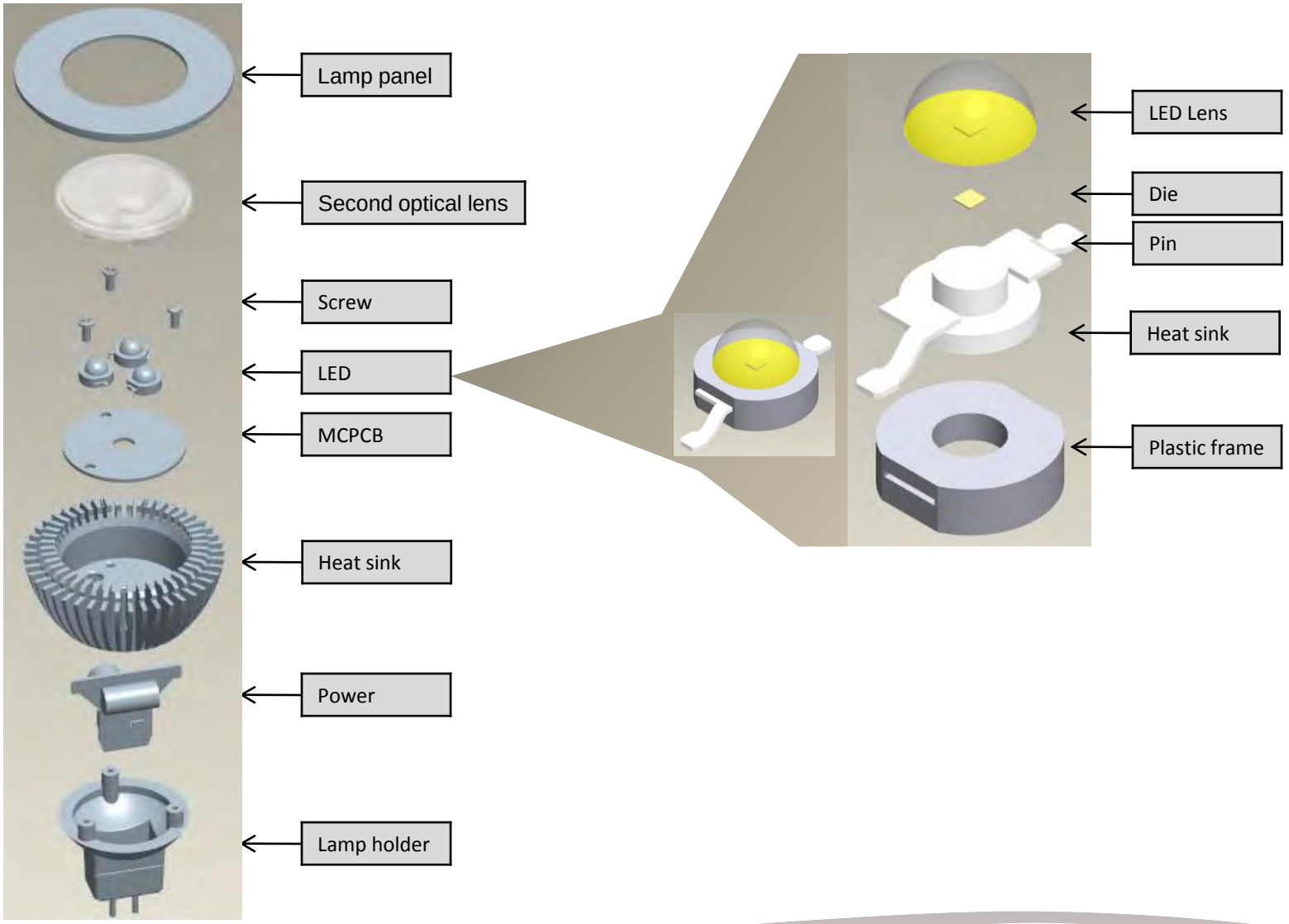
MR16-3W

Thermal simulation report

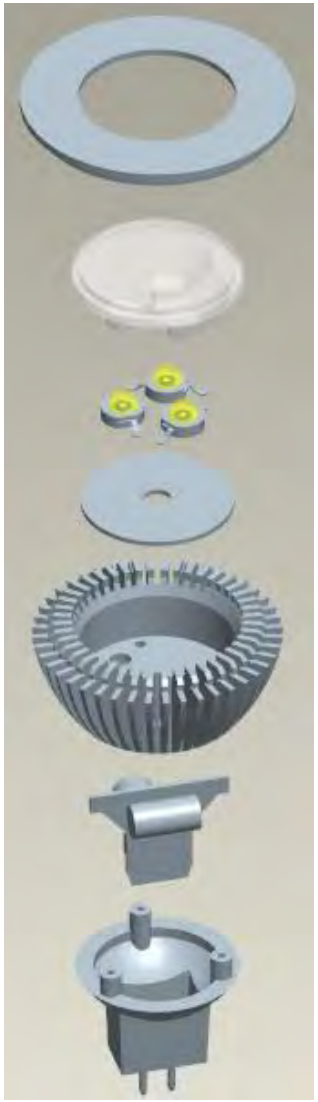


By Johnson
2010/03/31

Physical model decomposition diagram

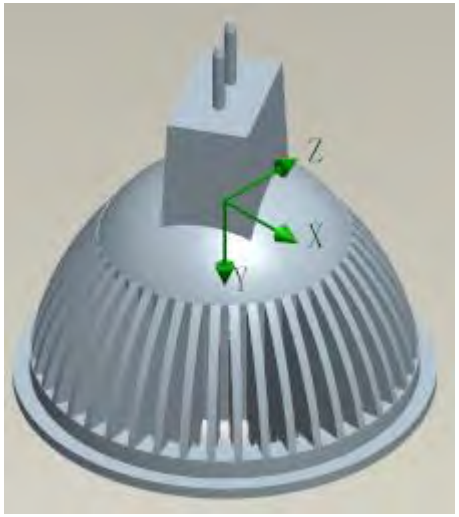


Simulation model decomposition diagram



Note: The simulation model has been simplified to remove that do not affect the thermal performance of small features, such as screws, screw thread, small hole, round corner, chamfer, etc, in order to reduce the computing time.

coordinate direction



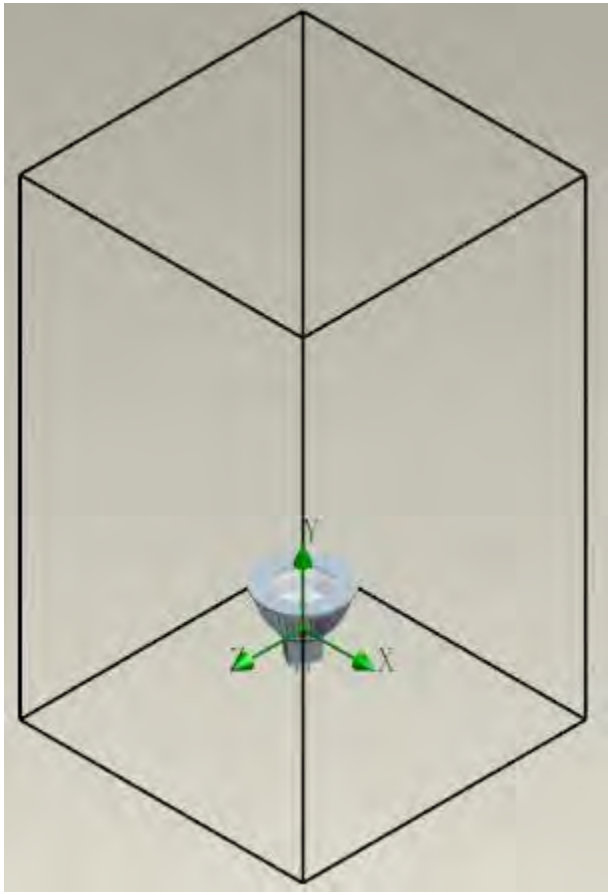
Computational Domain

Size

X min	-0.09 m
X max	0.09 m
Y min	-0.05 m
Y max	0.25 m
Z min	-0.09 m
Z max	0.09 m

Boundary Conditions

At X min	Open, Heat exchange
At X max	Open, Heat exchange
At Y min	Open, Heat exchange
At Y max	Open, Heat exchange
At Z min	Open, Heat exchange
At Z max	Open, Heat exchange



Physical Features

Heat conduction in solids: On
Radiation: On
Solution type: Steady state
Gravitational effects: On
Flow type: Laminar and turbulent
High Mach number flow: Off
Humidity: Off
Default roughness: 0 micrometer

Gravitational Settings

X component	0 m/s^2
Y component	-9.81 m/s^2
Z component	0 m/s^2

Ambient Conditions

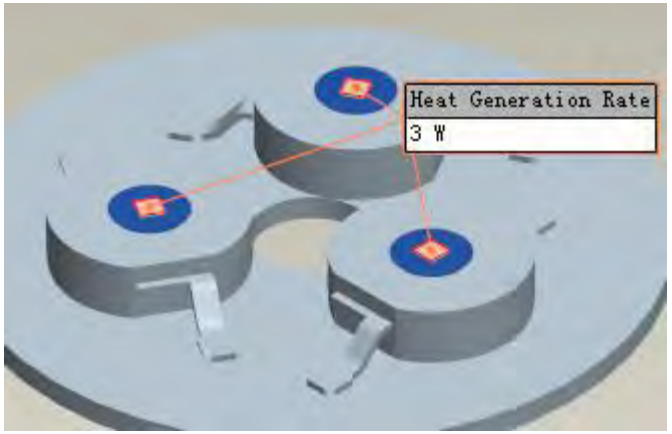
Thermodynamic parameters	Static Pressure: 101325 Pa Temperature: 35 ° C
Velocity parameters	Velocity vector Velocity in X direction: 0 m/s Velocity in Y direction: 0 m/s Velocity in Z direction: 0 m/s
Solid parameters	Initial solid temperature: 36° C
Turbulence parameters	Turbulence intensity and length Intensity: 0.1 % Length: 0.000493 m

Material Settings

Components	Material
Fluids	Air
Lamp holder	ABS
Power	Typical TQFP
Heat sink	Aluminum
MCPCB	Aluminum5052
LED Lens	Silicone
Die	Silicon Carbide
Pin	Aluminum
Plastic frame	PPA
Lamp panel	Aluminum
Second optical lens	PMMA

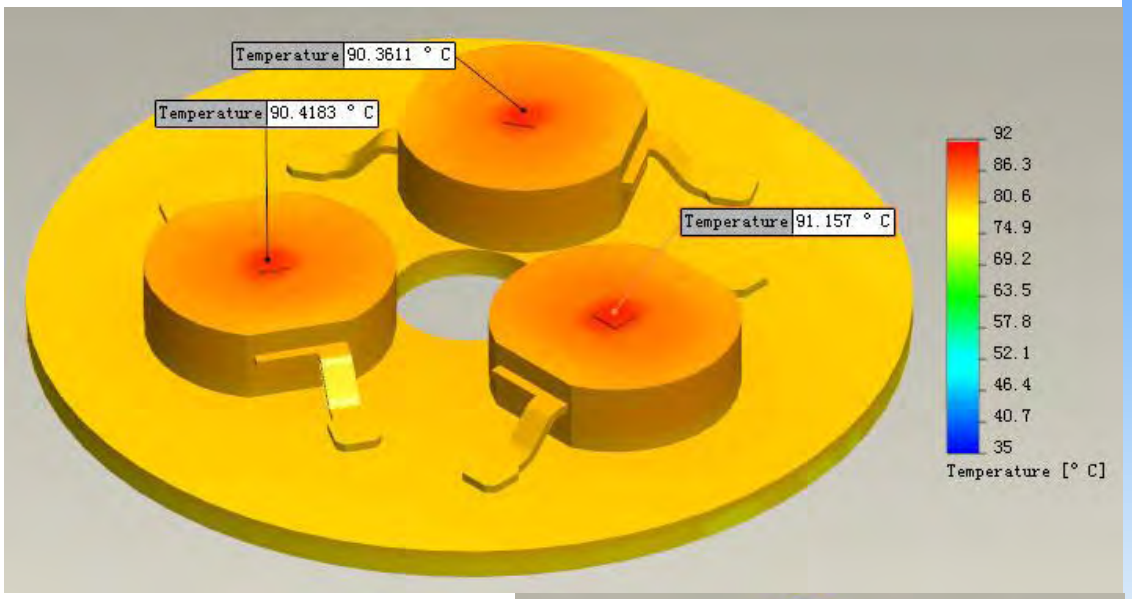
Heat sources

Single LED Die:1W
Total:3x1=3W

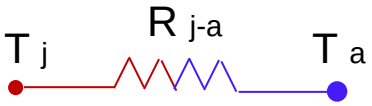


Results

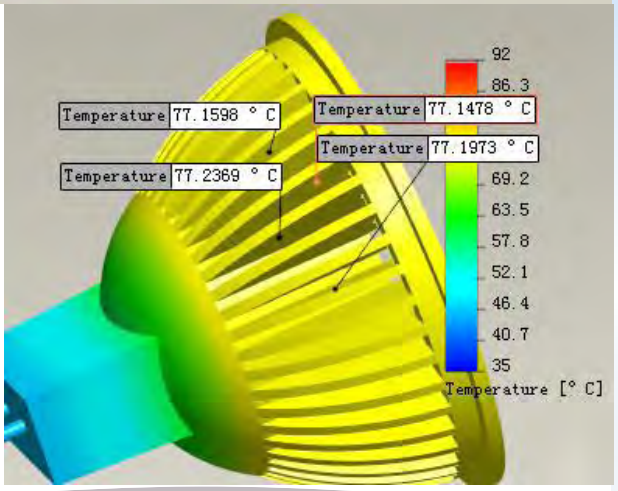
Name	Temperature (℃)
T_{j1}	90.4
T_{j2}	90.4
T_{j3}	91.2
T_{fin}	77.2



Thermal resistance



$R_{j\text{-}a}=(T_j-T_a)/W=(90.7-35)/3=18.57$ (℃ /W)



Note:

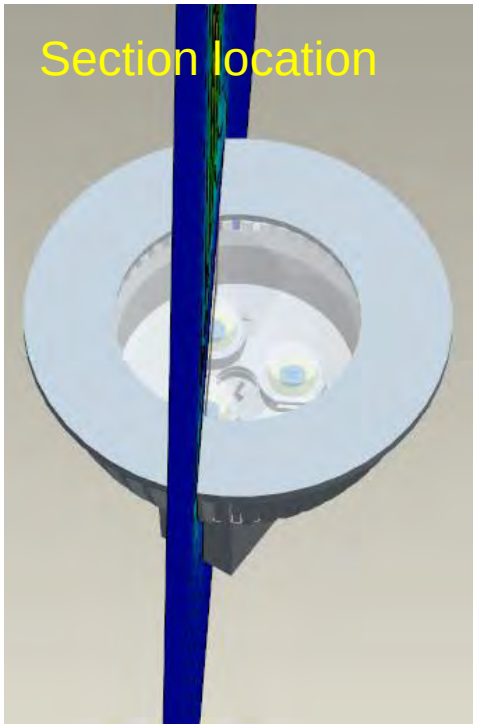
T_j ----- LED junction temperature

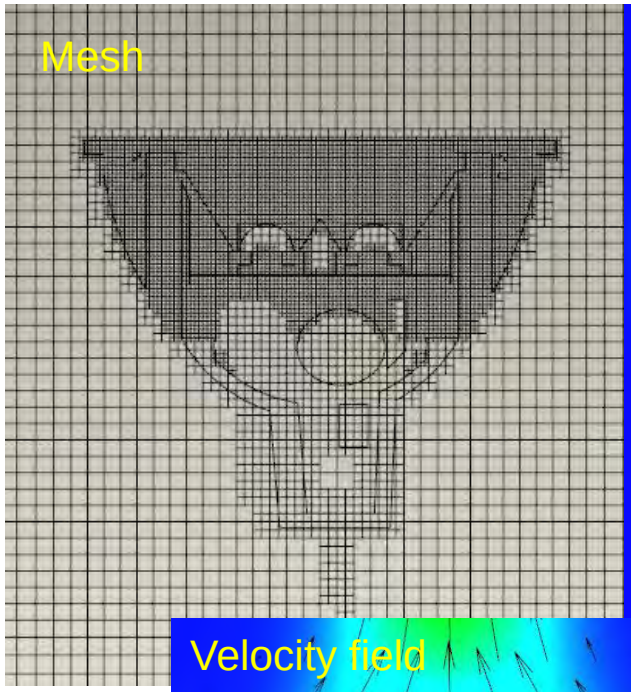
T_{fin} -----Heat sink fin temperature

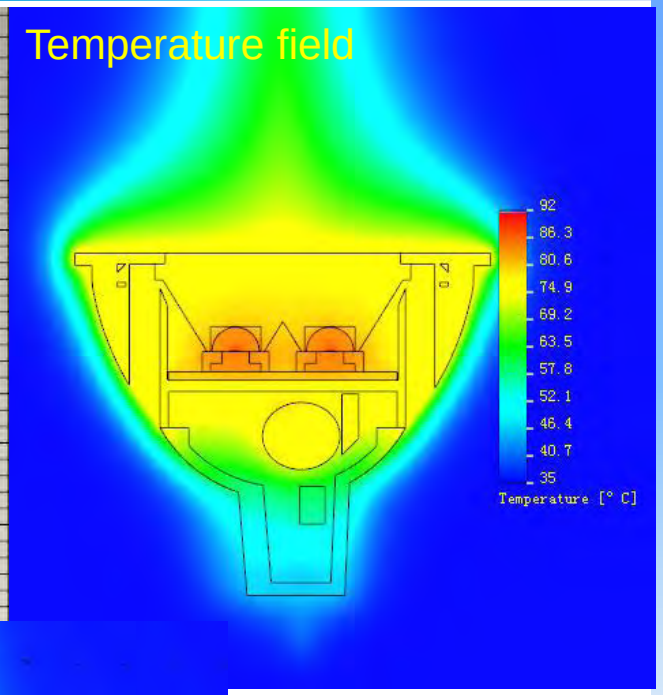
T_a -----Ambient temperature

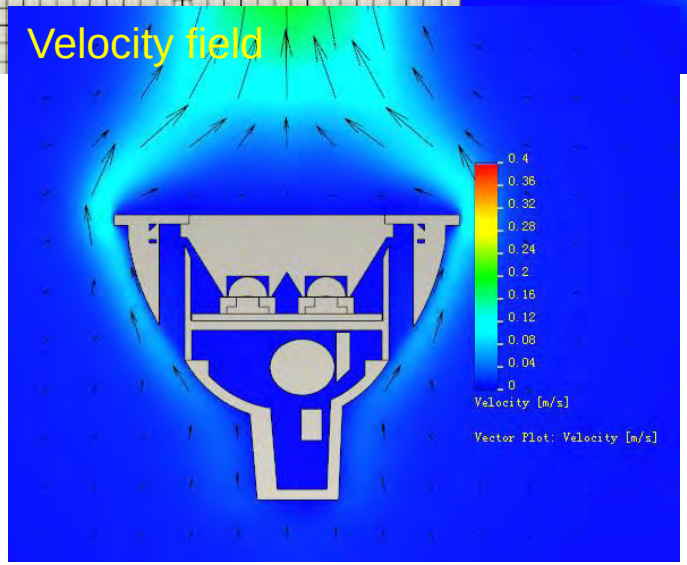
$R_{j\text{-}a}$ ----- Junction-to-ambient thermal resistance

Plot

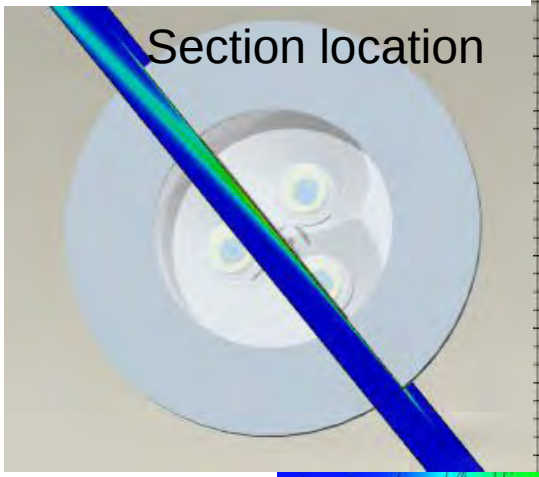

Section location

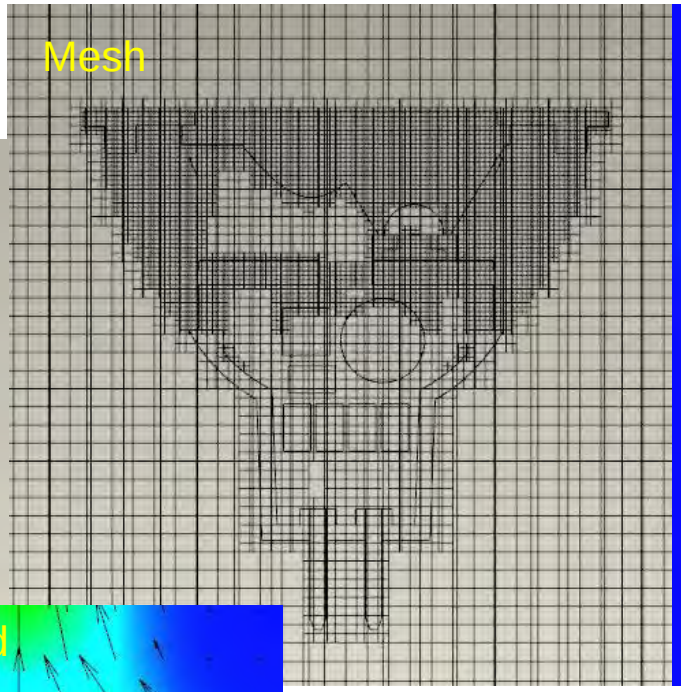

Mesh

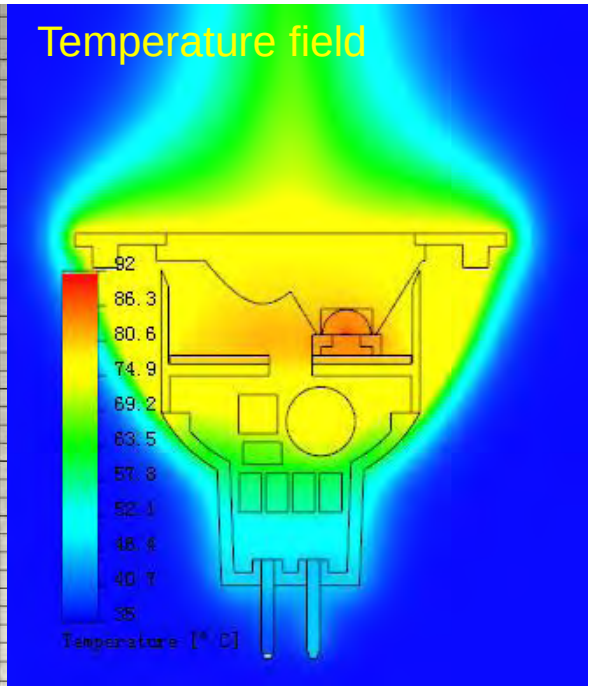

Temperature field
92
86.3
80.6
74.9
69.2
63.5
57.8
52.1
46.4
40.7
35
Temperature [° C]

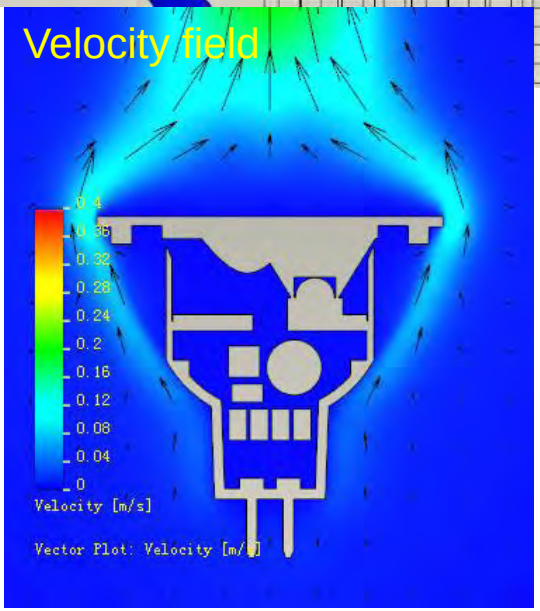

Velocity field
0.4
0.36
0.32
0.28
0.24
0.2
0.16
0.12
0.08
0.04
0
Velocity [m/s]
Vector Plot: Velocity [m/s]

Plot

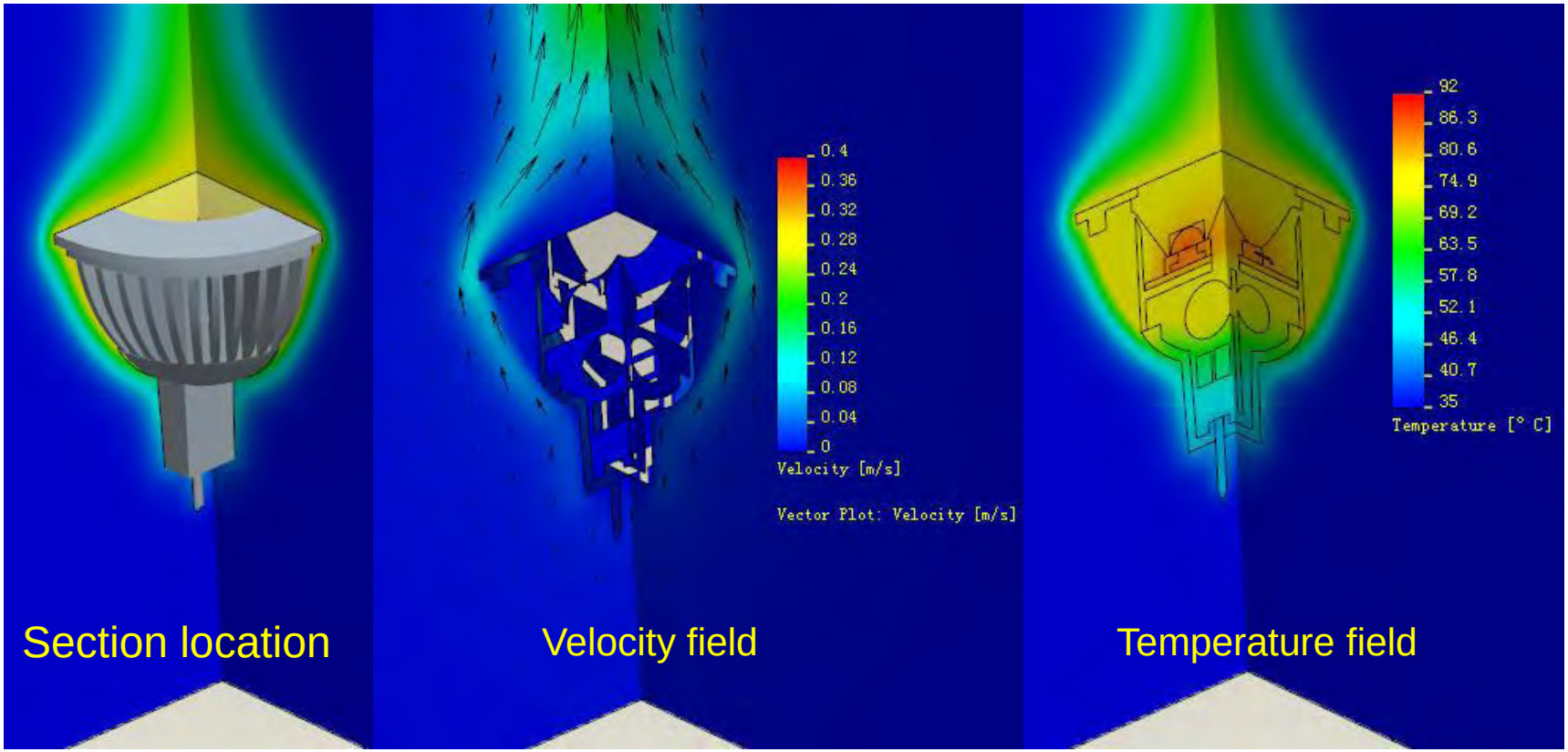

Section location


Mesh

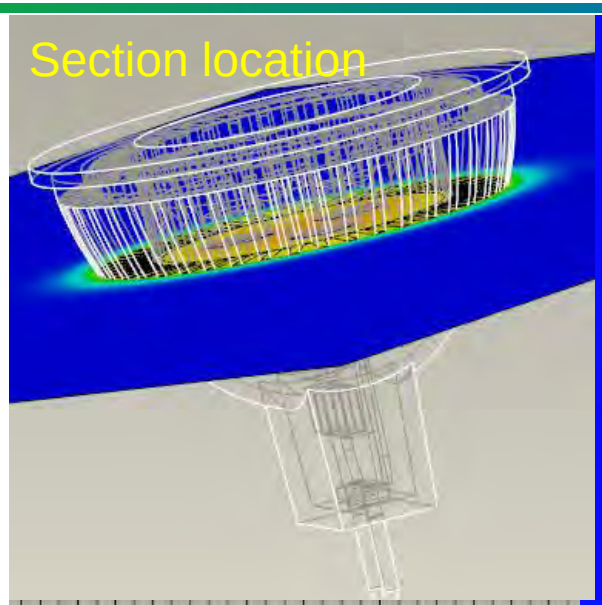

Temperature field
92
86.3
80.6
74.9
69.2
63.5
57.8
52.1
46.4
40.7
35
Temperature [° C]

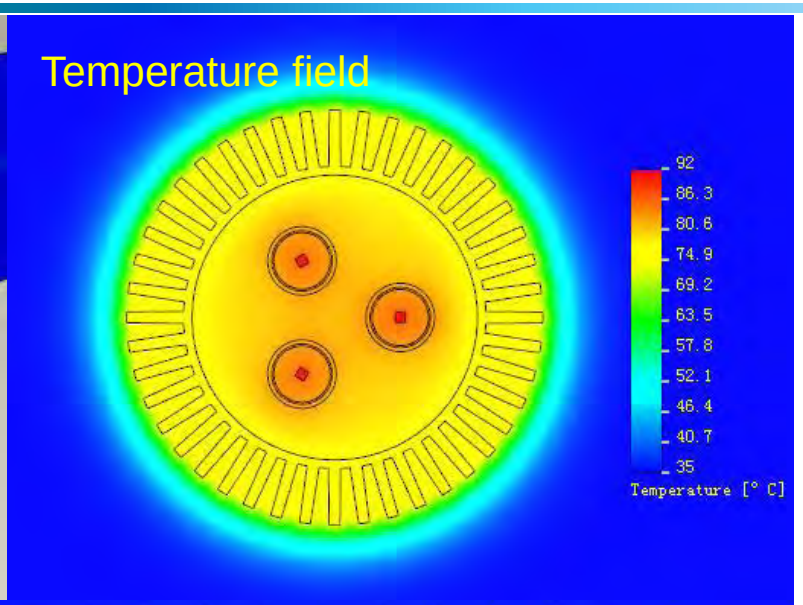

Velocity field
0.4
0.36
0.32
0.28
0.24
0.2
0.16
0.12
0.08
0.04
0
Velocity [m/s]
Vector Plot: Velocity [m/s]

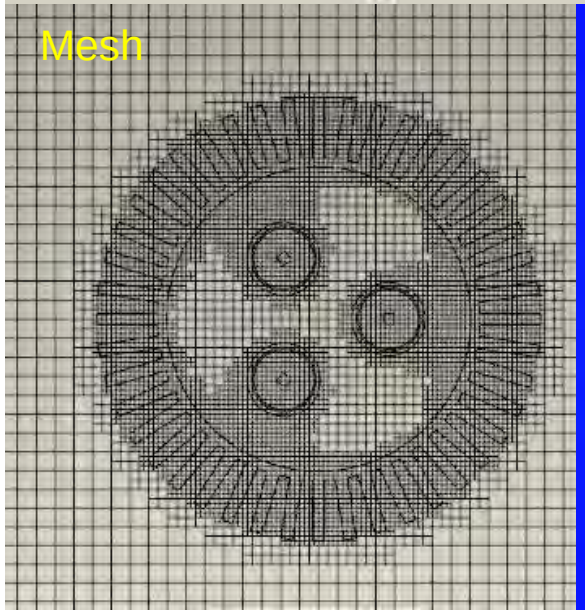
Plot

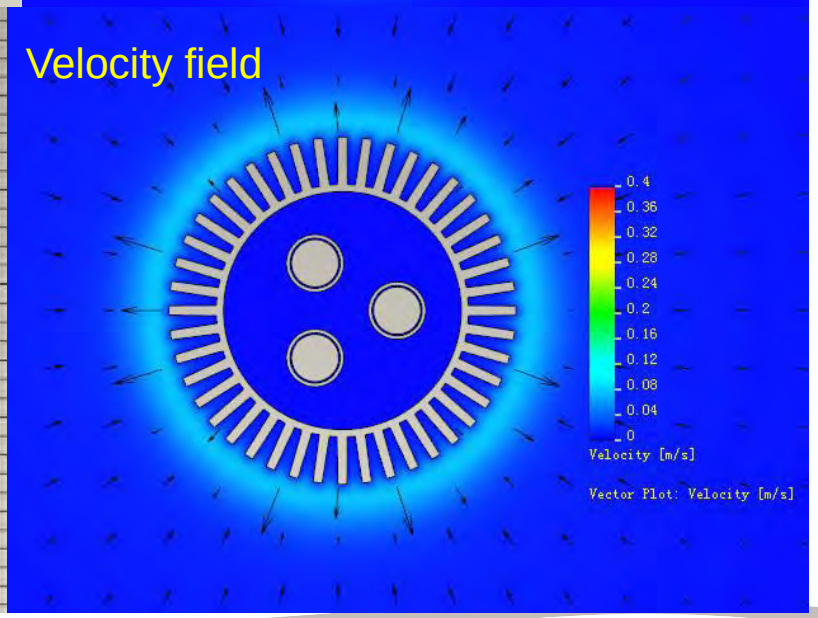

0.4
0.36
0.32
0.28
0.24
0.2
0.16
0.12
0.08
0.04
0
Velocity [m/s]
Vector Plot: Velocity [m/s]
92
86.3
80.6
74.9
69.2
63.5
57.8
52.1
46.4
40.7
35
Temperature [° C]
Section location
Velocity field
Temperature field

Plot

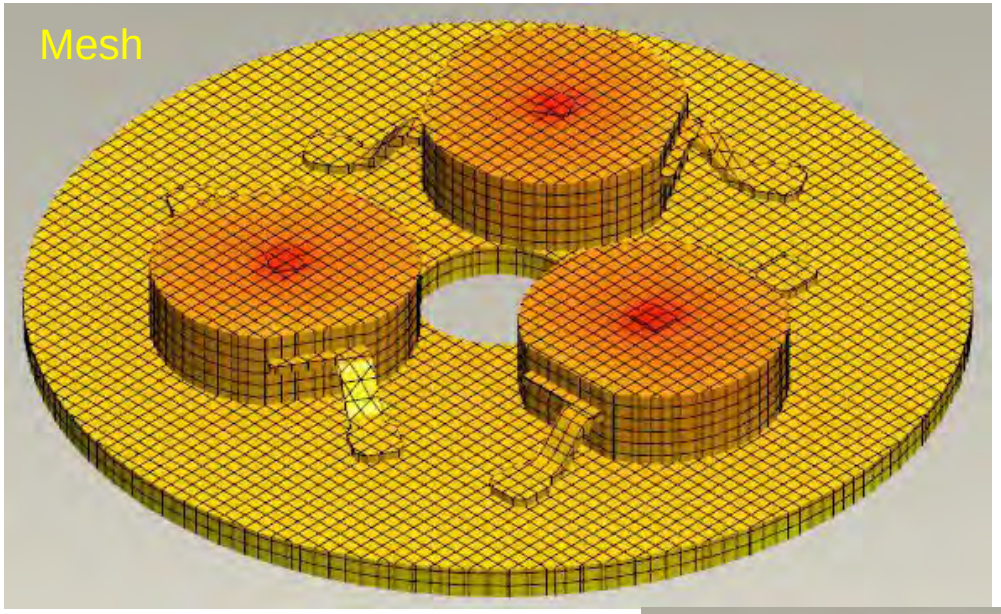

Section location

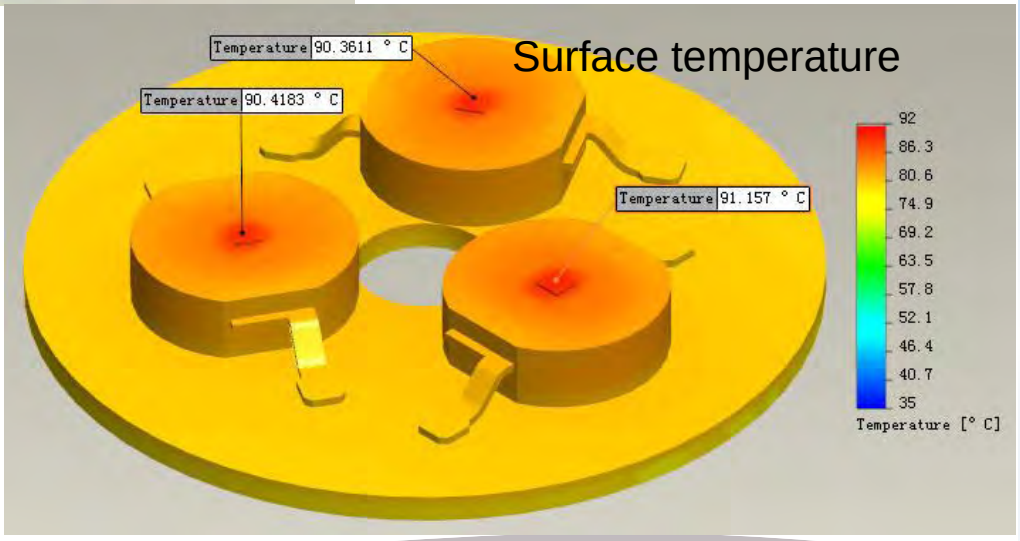

Temperature field
92
86.3
80.6
74.9
69.2
63.5
57.8
52.1
46.4
40.7
35
Temperature [° C]


Mesh

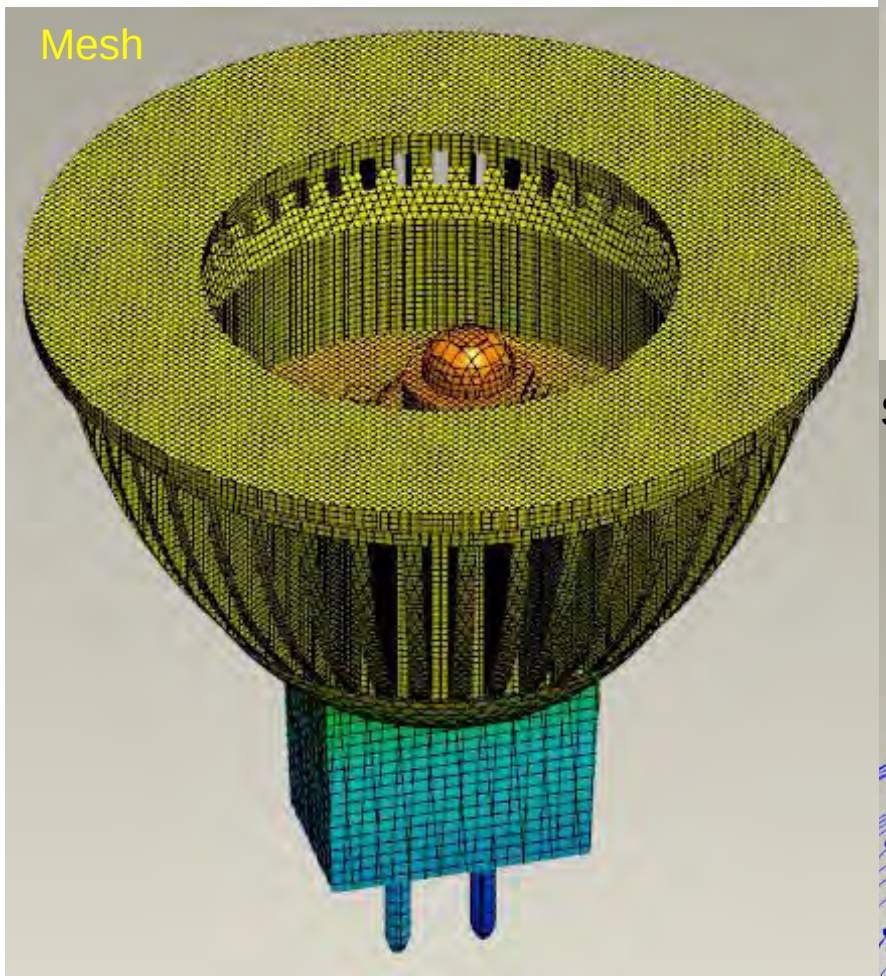

Velocity field
0.4
0.36
0.32
0.28
0.24
0.2
0.16
0.12
0.08
0.04
0
Velocity [m/s]
Vector Plot: Velocity [m/s]

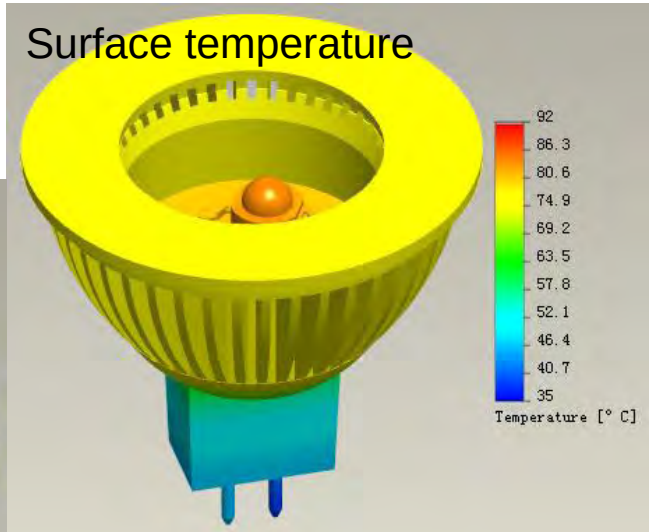
Plot

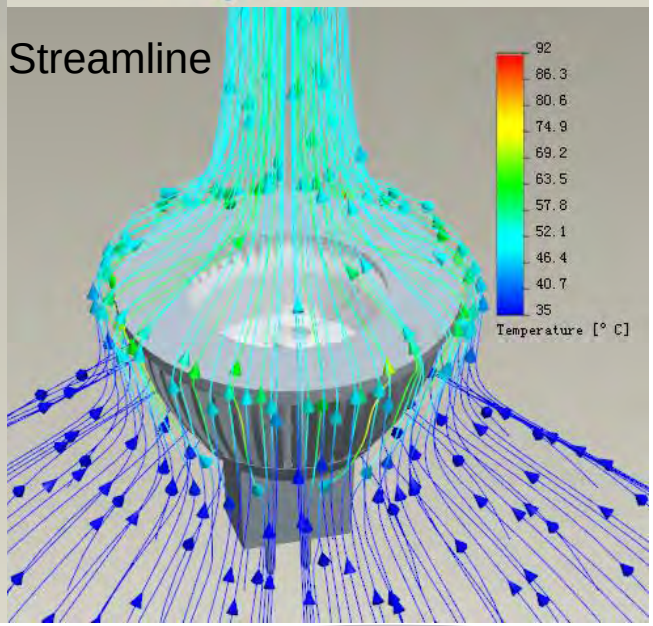

Mesh


Surface temperature
Temperature 90.3611 ° C
Temperature 90.4183 ° C
Temperature 91.157 ° C
92
86.3
80.6
74.9
69.2
63.5
57.8
52.1
46.4
40.7
35
Temperature [° C]

Plot


Mesh


Surface temperature
92
86.3
80.6
74.9
69.2
63.5
57.8
52.1
46.4
40.7
35
Temperature [° C]


Streamline
92
86.3
80.6
74.9
69.2
63.5
57.8
52.1
46.4
40.7
35
Temperature [° C]

Conclusion

When the ambient temperature is 35 ℃,the temperature of LED junction is 90.7 ℃,and the design value of standard junction temperature is 100 ℃,so the designs of this lamps accord with the thermal design requirement.

Accessories

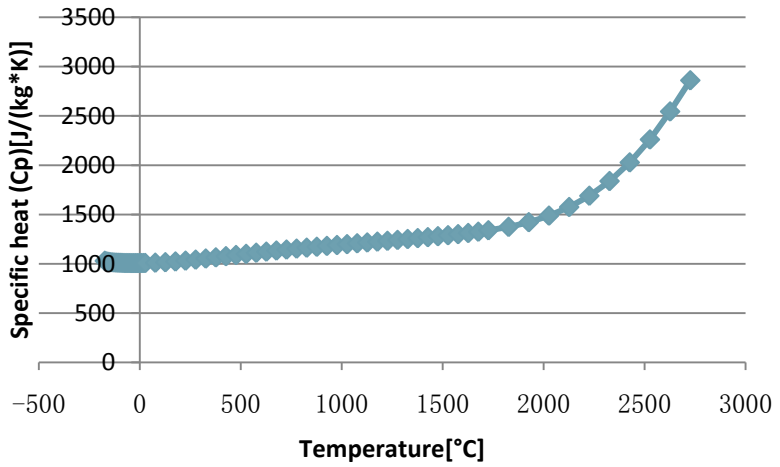
Gases:

Air

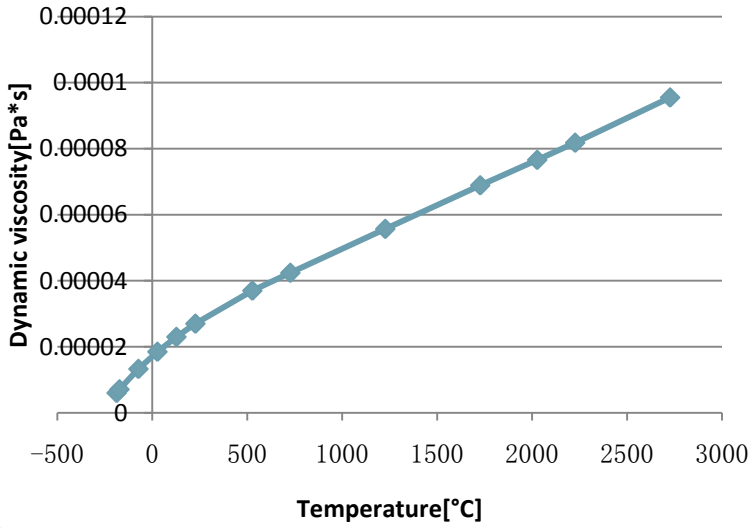
Specific heat ratio (Cp/Cv): 1.399

Molecular mass: 0.02896 kg/mol

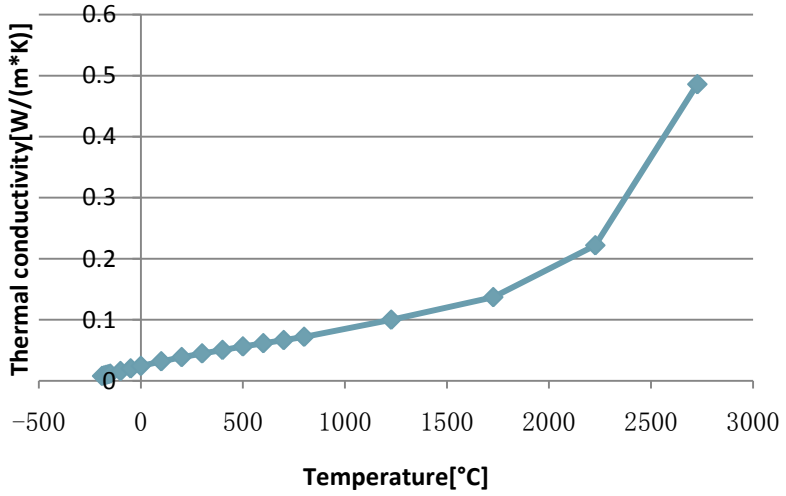
Specific heat (Cp)



Dynamic viscosity



Thermal conductivity

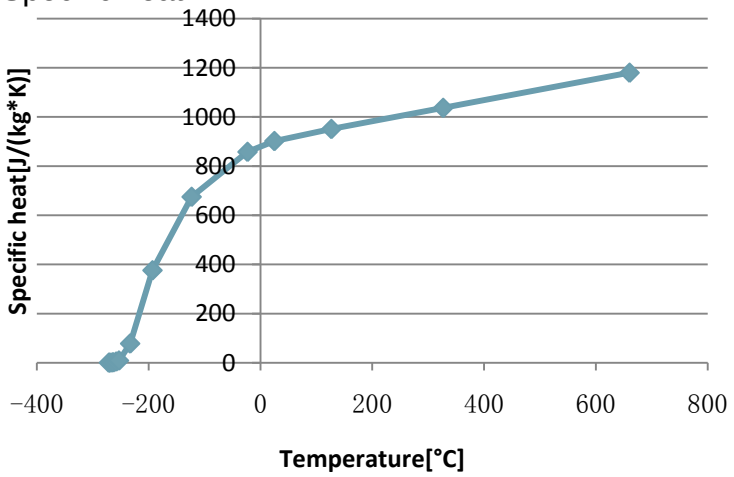


Solids

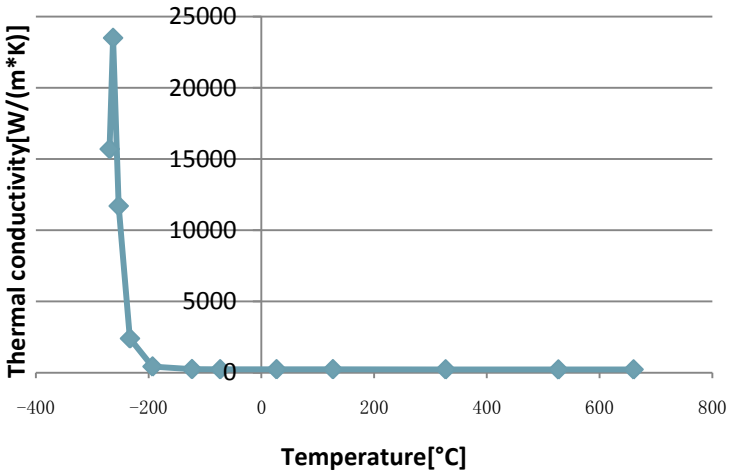
Aluminum

Density: 2688.9 kg/m^3
Conductivity type: Isotropic
Melting temperature: 660.25 ˚C

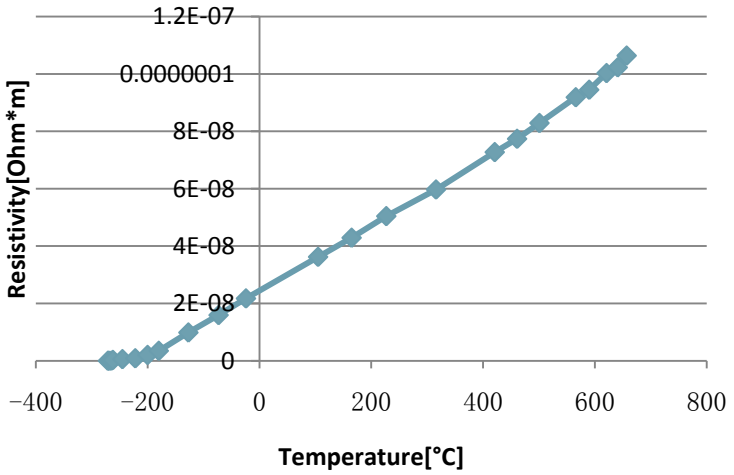
Specific heat



Thermal conductivity

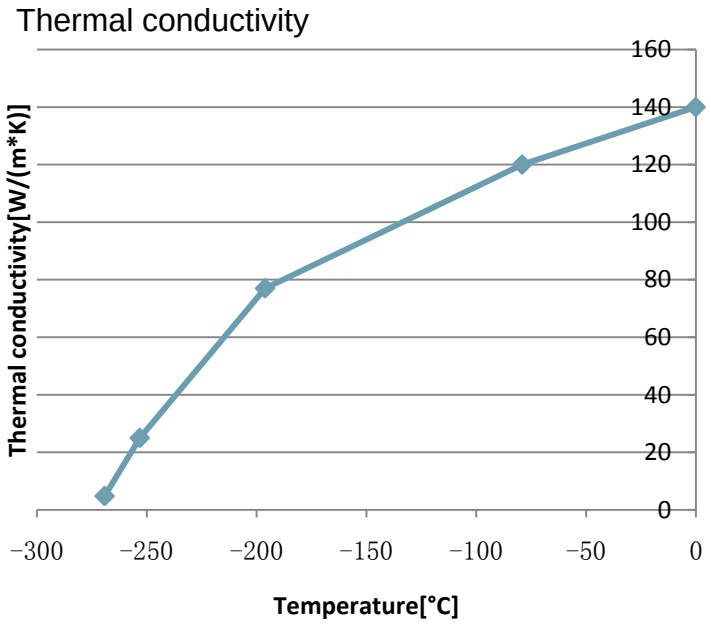


Resistivity



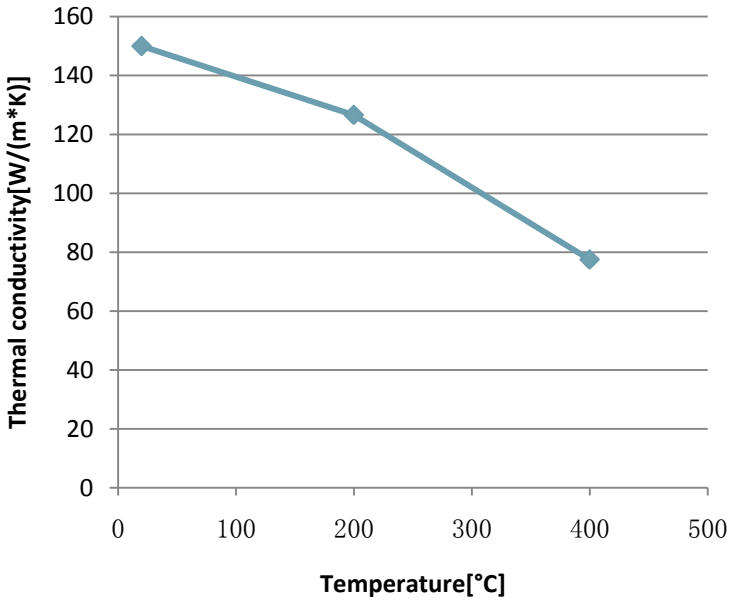
Aluminum 5052

Density: 2680 kg/m^3
Specific heat: 921 J/(kg*K)
Conductivity type: Isotropic
Resistivity: 4.9e-08 Ohm*m
Melting temperature: 607.23 ˚C



Silicon Carbide

Density: 3000 kg/m^3
Specific heat: 710 J/(kg*K)
Conductivity type: Isotropic
Melting temperature: 2700 ˚C
Thermal conductivity



ABS (Acrylonitrile Butadiene Styrene ,Molded)

Density: 1050 kg/m^3
Specific heat: 2050 J/(kg*K)
Conductivity type: Isotropic
Thermal conductivity: 0.189 W/(m*K)
Melting temperature: 135 ˚C

Typical TQFP

Density: 2000 kg/m^3
Specific heat: 800 J/(kg*K)
Conductivity type: Isotropic
Thermal conductivity: 0.2 W/(m*K)
Melting temperature: 1415.05 ˚C

PPA(Polyphthalamide)

Density: 1490 kg/m^3
Specific heat: 1968 J/(kg*K)
Conductivity type: Isotropic
Thermal conductivity: 0.49 W/(m*K)
Melting temperature: 311˚C

Silicone

Density: 1210 kg/m^3
Specific heat: 1460 J/(kg*K)
Conductivity type: Isotropic
Thermal conductivity: 0.423 W/(m*K)
Melting temperature: 316 ˚C

PMMA (Acrylic, Optical Grade, Molded)

Density: 1170 kg/m^3
Specific heat: 1430 J/(kg*K)
Conductivity type: Isotropic
Thermal conductivity: 0.207 W/(m*K)
Melting temperature: 146 ˚C